THE

PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES.

FOR THE YEAR

1909.

Vol. XXXIV.

WITH SIXTY-NINE PLATES.

Sydney:

PRINTED AND PUBLISHED FOR THE SOCIETY

BY

F. CUNNINGHAME & CO., 146 PITT STREET,

AND

SOLD BY THE SOCIETY.

1909-10.

F. CUNNINGHAME & CO.,
LETTERPRESS AND LITHOGRAPHIC PRINTERS,
PITT STREET, SYDNEY.

LIST OF CONTRIBUTORS AND TITLES OF PAPERS.

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PART IV. (No. 136).

(Issued March 12th, 1910)

LIST OF PLATES.

PROCEEDINGS, 1909.

CORRIGENDA.

Page 21, line 28—for *Galanxaura* read *Galaxaura*.
Page 122, line 28—for *Germaria liliputanus* read *Germaria liliputana*.
Page 124, line 17—for *E. pyritosa* read *D. pyritosa*.
Page 125, line 17 }
Page 125, line 19 } -for *N. cœrulescens* read *M. cœrulescens*.
Page 218, line 12—for *Trichosoma hepatica* read *Trichosoma hepaticum*.
Page 230, line 11—*for* Emmonds *read* Emmons: and supply the reference—*U.S. Geol. Surv., Topographic Atlas, Folio 38, On Butte, Montana.
Page 418, line 20—for *S. miescheriana* read *S. meischeriana*.
Page 431, line 3—for *G. æquiroca* read *G. æquiroeum*.
Page 434, line 23—for SEMELE ISOCELES read SEMELE ISOSCELES.
Page 503, line 28—for *H. crysops* read *H. chrysopis*.
Page 518, line 5—for *Zoniolaimus setifera* read *Zoniolaimus setifer*.
Page 518, line 31—for *Thysanosoma fimbriata* read *Thysanosoma fimbriatum*.
Plate LXV.—The divisions on the left hand end of the scale represents hundreds of yards; those on the right hand end, quarter miles.

LIST OF NEW GENERIC AND SUBGENERIC NAMES

PROPOSED IN THIS VOLUME (1909).

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PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES.

WEDNESDAY, MARCH 31st, 1909.

The Thirty-fourth Annual General Meeting, and the Ordinary Monthly Meeting, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 31st, 1909.

ANNUAL GENERAL MEETING.

Mr. A. H. S. Lucas, M.A., B.Sc., President, in the Chair.

The Minutes of the preceding Annual General Meeting (March 25th, 1908) were read and confirmed.

The President delivered the Annual Address.

PRESIDENTIAL ADDRESS.

The year we are now concluding has been one of quiet and steady work, unmarked by any special departure from our usual programme. In numbers we have made a small increase, ten Ordinary Members having been elected during the year, while we have lost two Associate Members by resignation and two Ordinary Members by death. Sir Arthur Renwick and Sir John Hay were both men of mark in the community. They were not actively or directly interested in any particular branch of science, but their connection with this Society was evidence of appreciation, on the part of two broad-minded, far-seeing men of affairs, of what Science stands for, and of the necessity for its cultivation, in a young community in which the natural resources are in a comparatively early stage of development, and need to be dealt with wisely, and with due regard to the experience which has been gained in older countries.

Sir Arthur Renwick's claims upon public gratitude rest upon a wide foundation—his long connection with the University as a very active Member of the Senate, and for some time Vice-Chancellor; his close association with the management of a number of the leading Charitable Institutions, and especially the Sydney Hospital, the Benevolent Society of New South Wales, the Royal Hospital for Women at Paddington, the Institution for the Deaf and Dumb, and Blind, and the State Children's Relief Department; his public services, as a Member of the Lower House for some years, and for a time Minister for Mines, subsequently Minister for Education, and latterly Member of the Upper House. Sir Arthur, a medical man of long and high standing, joined the Society in 1905. His death took place on 23rd November, 1908, in his 72nd year.

Sir John Hay joined the Society in 1899. He was best known to us as the successor to the famous Berry Estates in the Shoalhaven District and elsewhere. The opportunity of taking the lead in developing the capabilities of the celebrated Shoalhaven District, and of furthering closer settlement was readily accepted by him, and was utilised in a manner which did credit alike to heart and brain. Sir John Hay died on 26th February, 1909, in his 69th year; and he is widely and sincerely mourned.

The Treasurer's statement last year was made by the Secretary on behalf of Mr. J. R. Garland, who was at that time, to the great regret of the Society, laid aside by severe indisposition. So serious indeed was his illness, that Mr. Garland reluctantly felt compelled to retire from the office of Treasurer, and the Society with equal reluctance accepted the resignation. In May, the Council accordingly elected Mr. J. H. Campbell, of the Imperial

Mint, to succeed Mr. Garland as Treasurer. Mr. Campbell had speedily shown a complete mastery of the financial affairs of the Society, and had inspired confidence that the accounts were in capable hands. At the same time we are glad to know that Mr. Garland has quite recovered his health and strength, and is able to assist the Council with his advice and experience.

In October, at a Special General Meeting, it was decided to amend Rule xlv. relating to the annual audit of the Society's accounts. On the motion of the Hon. Treasurer, Mr. Campbell, seconded by Mr. T. Steel, it was resolved that the Rule should read—xlv. The accounts of the Treasurer shall be audited annually, a short time before each Annual Meeting, by an Auditor, not a Member of the Society, who shall be a Public Accountant actively practising his profession, and who shall have been elected at the previous Annual or a Special General Meeting, . . . and the accounts so audited, with the Report of the Auditor, shall be laid before the Society at each Annual Meeting.

Due acknowledgment was made of the indebtedness of the Society to the Members who had acted as Honorary Auditors in the past, and had served the Society with courtesy and readiness, often at considerable personal inconvenience, but it was felt that the appointment of a single outside and professional Auditor would result in the saving of time and in the simplification of the arrangements for the annual audit. The new arrangement had accordingly come into force.

The results of the labours of Members during the year appear in a volume of over 900 pages—the thirty-third of the series—which had been promptly completed and distributed. It comprised thirty papers, two of them of more than average length. The Council is indebted, as on previous occasions, to Mr. C. Hedley for presenting the blocks for the illustrations of his paper, appearing in Part 3 of the Proceedings.

The work of the Macleay Bacteriologist appears in the paper published in the Proceedings upon "Opsonisation from a Bacterial Point of View and Opsonic Technique." The subject of opsonisation is an important one on account of the large amount of work that is being done upon it in bacterial laboratories throughout the world, and of the benefits that are claimed to accrue to mankind from the indications which are given in the practice of the method. It may be briefly said that opsonins are the substances which exist in the blood for the purpose of so preparing infectious bacteria that they can be speedily absorbed by the phagocytes, and finally destroyed. A low opsonic content indicates a low power of resistance, and conversely a high opsonic index shows that the individual is well equipped to withstand bacterial infection. It is also possible in obscure cases to diagnose the kind of disease from the opsonic behaviour of the serum towards various bacteria. Hitherto opsonic investigation had been directed towards the serum, but the Macleay Bacteriologist turned his attention towards the bacterium, noting the effect of conditions of growth, age, temperature, and so on. Various factors which modify bacteria in their behaviour towards the opsonins were elucidated.

Dr. J. M. Petrie, Linnean Macleay Fellow of the Society in Biochemistry, during 1908, carried on his investigations on the rôle of Nitrogen and its compounds in plant-metabolism; and the first instalments of the results were embodied in two papers which appeared in the last Part of the Proceedings. Subsequently, in preparation for a third paper on the same subject, Dr. Petrie began a series of experiments with the object of attempting to differentiate the proteins by fractional precipitations, and to estimate the amounts of the amides, of amino-compounds, and certain basic compounds present in seeds. Though a number out of a rather lengthy series of experiments gave negative results, they were necessary in carrying out his projected scheme of work. In addition, Dr. Petrie has been successfully collaborating with Dr. Chapman in carrying out an investigation of the hexone bases of egg albumen. I have pleasure in announcing that the Council has reappointed Dr. Petrie to a Fellowship from the 1st proximo.

Mr. E. J. Goddard, B.A., B.Sc., Linnean Macleay Fellow of the Society in Zoology, has almost completed his first year's tenure of a Fellowship, during which he has applied himself energetically to the study of freshwater Oligochæta and Hirudinea. Four papers dealing with exceptionally interesting or specially important forms of both groups have appeared in the second and fourth Parts of the Proceedings for 1908. Subsequent studies of these groups of a more comprehensive and systematic character are well advanced, and, in addition, the freshwater Polyzoa are engaging his attention. I have pleasure in announcing that the Council has reappointed Mr. Goddard to a Fellowship from the 1st prox.

In December last, inasmuch as the accumulation of the funds permitted it, and very promising candidates were forthcoming, the Council decided to elect a third Fellow; and I have very great pleasure in making the first public announcement of the election of Mr. Leo A. Cotton, B.A., B Sc., in this capacity.

Mr. Cotton has had a brilliant career at the Sydney University, graduating both in Arts and in Science, and obtaining First Class Honours in Mathematics in each year, First Class Honours in Physics, the Smith Prize for Physics, the Slade Prize for Practical Physics, High Distinction in Chemistry and Physics, the Deas Thomson Scholarship in Geology, Professor David's Prizes in Geology, and the John Coutts Scholarship in Geology, and has held the position of Demonstrator in Geology during 1908. Mr. Cotton selected Geology as his branch of study, and more particularly Geology in its relation to Ore-deposition, more especially in the New England District. In entering upon his work a few days hence, Mr. Cotton may rest assured of the Society's hearty congratulations and good wishes.

For the first time in its history, then, the Society will have four investigators, including three Fellows, at work under its auspices during the coming Session. This will be the nearest possible approach to the complete realisation of Sir William Macleay's scheme for the endowment of research which existing circumstances permit for the present. The oversight of these varied and seriously undertaken attempts to enlighten ignorance and broaden and deepen knowledge has now become part of the

Society's regular work, and its import may not be lost sight of. Perhaps it may help to remind us of this if I state that, with the close of the current Session, the total amount of the salaries paid to the Society's investigators will be £6,600, in addition to the sum spent on the equipment and maintenance of the Bacteriological Laboratory.

In October, in response to a request from the West Australian Natural History Society at Perth, the Council, whose action was afterwards heartily endorsed by the Society, forwarded a letter to the Premier of West Australia strongly supporting the appeal of the West Australian naturalists that Barrow Island, remarkable for unique species of *Macropus*, *Perameles*, *Mus* and *Malurus*, should be set aside as a reserve, and should not be leased for sheep-farming. The Council in consequence received with much gratification a courteous personal letter from the Premier of West Australia, informing them that the request to reserve the island had been granted by the West Australian Government.

In August the general question of the welfare of the indigenous flora and fauna, and the best means of their protection, was discussed at a large meeting. Messrs. A. J. North, of the Australian Museum, Frank Farnell, Chairman of the National Park Trust, F. J. W. Harrison, Secretary of the Trustees of the Kuring-Gai Chase, F. M. Rothery, Secretary of the Animals' Protection Society, J. H. Maiden, Secretary of the Royal Society of New South Wales, and R. Etheridge, Curator of the Australian Museum, attended and gave the views of their respective Societies or Institutions. A sub-committee was appointed to confer with the other Societies so as to promote cooperation in an appeal to the Government. The sub-committee met twice, but owing to various causes no practical result has yet been achieved.

The year 1908 being the Jubilee of the Theory of Natural Selection as propounded by Charles Darwin and Alfred Russel Wallace in 1858, it was decided to send a letter of congratulation on the occasion to Dr. Wallace in residence at Broadstone, England. The letter was accordingly drawn up and despatched, and in September a courteous reply of thanks was received from the veteran Biologist. This letter is preserved in the archives of the Society.

The present year is alike the Centenary of Darwin's birth (February, 1809) and the Jubilee of the publication of the "Origin of Species" (November, 1859). If opportunity arises, the Society will doubtless take steps to join in the celebrations.

It is gratifying to learn that the University of Sydney is establishing Chairs of Agriculture and Veterinary Science. For the material development of the State it is eminently desirable that all the main industries should be in close touch with the exponents of pure science, the manufacturers of knowledge. It is a truism that theory and practice react upon one another to the gain of both, and both the State and the University will do better work if the University realizes the practical needs of the State, and the State becomes imbued with the broader outlook of the University.

It is also satisfactory to know that the State Government has established a Bureau of Micro-Biology, which will be under the direction of a distinguished former Member of the Society, Dr. Tidswell, who will have working with him a scientific staff of four investigators. We gladly welcome this addition to the fighting forces of Science in the State.

The Report of the Commissioners of Forestry has been received by the Government, but up to the present no action has been taken. It is earnestly to be hoped that the Government will give practical and prompt effect to the recommendations of the Commissioners, and that, before it is altogether too late, a wise policy of protection and control of our invaluable and unique forests will be adopted. The care and improvement of our forests is probably the most urgent of the duties of our Government, and should be placed well above and beyond all considerations of party. As it is, the nation appears to be blind to the wanton destruction of one of its most valuable and permanent assets.

I have to thank Mr. Maiden for the opportunity of showing you an advance copy of his work, "Sir Joseph Banks: 'The Father of Australia,'" and I have pleasure in commending it to your favourable notice. Notwithstanding the disadvantage of being cut off from the important sources of information about Sir Joseph Banks which are only accessible to a biographer who lives in, or can visit, England, Mr. Maiden has succeeded in producing a work which will go a considerable way in supplying a long felt want. Many Australians to whom the existing biographical sketches and eulogia are not available for various reasons, have been patiently waiting to be supplied with a book which will bring home to them more fully and intelligibly the personality of Sir Joseph Banks and those of his associates in whom we are especially interested, and their share in or connection with the colonisation of Australia. The compilation of this meritorious and useful book has been a labour of love on Mr. Maiden's part. No presentation copies are promised, so that the entire sum accruing from the sale of the work may be added to the fund to be raised for providing some permanent memorial of Banks.

The "Nimrod," with the expedition led by the intrepid Lieutenant Shackleton, has returned from Antarctica, and our heroic Member, Professor David, is amongst us again, after a strenuous year of hardships and labours most abundant, including the ascent of Mount Erebus and a personal visit to the Magnetic South Pole. It is difficult to express our joy at his safe return in terms of reasonable enthusiasm. Our hearts are all lighter to know that he is back again, and they are all the lighter because Mrs. David's heart is lighter. We shall await with the liveliest anticipation the accounts which Professor David and his good comrades, including our fellow-Member Mr. Mawson, have in store for us, of their adventures and investigations in the Great Lone South.

Last year I endeavoured to put before you what I believe to be the true relations between Science and Good Government, with illustrations of the most urgent needs of the State for the scientific development of our resources. This year, with your permission, I will not discuss a general subject, but rather lay before you a result of the special work to which I have devoted myself during the last ten years, the study of the Australian

Algæ. And I think, at this stage, that the most useful publication I can make is a classified list of the known forms of our algal flora, as far as concerns the groups of Brown and Red Seaweeds. In 1863, Harvey published his Synopsis, enumerating 719 species. In 1880, Sonder, in Mueller's Fragmenta (Vol.xi.) gave an increased list of 923 forms. I have reckoned in both lists only the species of *Fucoideæ* and *Florideæ*. Since the latter date, several collections of Australian species have been referred to experts in Europe, and new species have been described by J. G. Agardh, Reinbold and others. Agardh has especially produced order out of chaos amongst the very numerous forms of *Sargassum* in a classical Monograph. Regrouping and rearrangement have resulted from the work of Schmitz and Falkenberg. Finally De Toni has produced his magnificent Sylloge Algarum, and incorporated in it most of the additions and re-casting. The names now accepted are in many cases altered from those used by Harvey in his Phycologia Australica, which is the only work generally available to Australian students. In the appended List, then, I have given the species as recorded in De Toni, following his classification as far as published, adding species since described, and giving, as far as I am able, the general geographical distribution of the species. The coasts only, N., S., E., W., are indicated, since details are wanting for anything like a precise extent of the range of most of the forms. The List includes about 1050 species. Harvey's names, where altered, are given as synonyms.

REVISED LIST OF THE *FUCOIDEÆ* AND *FLORIDEÆ* OF AUSTRALIA.

FUCOIDEÆ (Ag.) J. Ag.

Order **CYCLOSPORINÆ** Aresch.

Family SARGASSACEÆ (Decne.) Kuetz.

SARGASSUM Ag.

Subgen. PHYLLOTRICHA (Aresch.) J. Ag.

S. heteromorphum J. Ag. S., T.
S. halitrichum (Aresch.) J. Ag. W., S.

S. sonderi J. Ag. S.W., S., T.
S. muriculatum J. Ag. S., T.
S. linearifolium (Turn.) Ag. S., E.
S. peronii (Mert.) Ag. W., N.
S. decurrens (R. Br.) Ag. W., E.
S. boryi Ag. W., N.
S. scabripes J. Ag. N.
S. varians Sond. W., S., T.
S. decipiens (R. Br.) J. Ag. S., T.
S. trichophyllum J. Ag.
S. verruculosum (Mert.) Ag. S., T., N.Z.

Subgen. Arthrophycus J. Ag.

S. robustum J. Ag. W., E.
S. bracteolosum J. Ag. S., T.
S. lævigatum J. Ag. T., E.
S. fallax Sond. W.
S. paradoxum (R. Br.) Harv. S.
S. globulariæfolium J. Ag. S. E
S. vestitum (R. Br.) Ag. S., T.
S. rhynchophorum J. Ag. T.
S. gunnianum J. Ag. T.
S. grande J. Ag. S., T.
S. undulatum J. Ag. S., T.
S. ensifolium (Ag.) J. Ag. W., S.
S. erosum J. Ag. E.
S. lacerifolium (Turn.) J. Ag. S.W.
S. biforme Sond. S.W.
S. tristichum (Grev. & Ag.) Sond. S.W., S.
S. amaliæ Grun. E., Norfolk I.
S. membranaceum J. Ag. S., T.

Subgen. Eusargassum J. Ag.

S. angustifolium (Turn.) Ag. N.
S. carpophyllum J. Ag. N.
S. flavicans (Mert.) Ag. N.

S. fissifolium (Mert.) J.Ag. N.
S. cristatum J.Ag. S.
S. swartzii (Turn.) Ag. N.
S. binderi Sond. N.(?), Norfolk I.
S. ligulatum Ag. W.
S. subalatum Sond. W.
S. obovatum Harv. N.
S. berberifolium J.Ag. W.
S. cristæfolium J.Ag. W.
S. spinifex Ag. W., N., E., Norfolk I.
S. lophocarpum J.Ag. S., E.
S. ilicifolium (Turn.) Ag. N.
S. microcystum J.Ag. E.
S. biserrula J.Ag. W., N.
S. cinctum J.Ag. N.
S. coriifolium J.Ag. N.E.
S. claviferum J.Ag.
S. opacum J.Ag. N.
S. myriocystum J.Ag. N.E.
S. parvifolium (Turn.) Ag. N.
S. filifolium Ag. W., N.W.
S. pachycarpum J.Ag. T.
S. stenophyllum J.Ag. N., Norfolk I.
S. lanceolatum J.Ag. N.W.
S. desvauxii (Mert.?) Ag. W., S.
S. torvum J.Ag. N.
S. vulgare Ag. S.
S. neurophorum J.Ag. E.
S. acinaria (Turn.) J.Ag. N.
S. leptopodum J.Ag. S.
S. merrifieldiæ J.Ag. S.
S. podocanthum Sond. S.W.
S. polyacanthum J.Ag. S.E.
S. spinuligerum Sond. W., S., E., N.Z.
S. godeffroyi Grun. E., Norfolk I.
S. cystocarpum Ag. N.E.

S. granuliferum Ag. N.E.
S. aciculare Grun. E.
S. gracile J.Ag. N.
S. polycystum Ag. N.
S. baccularia (Mert.) Ag. N.
S. plagiophyllum (Mert.) Ag. N.
S. siliquosum J.Ag. N.
S. fragile J.Ag. E.

CARPOPHYLLUM Grev.

C. phyllanthus (Turn.) Hook. & Harv. S.W., S.E. (F.v.M.), N.Z.

TURBINARIA Lamour.

T. conoides Kuetz. N.
T. decurrens Bory. N.
T. trialata Kuetz. W.
T. ornata J.Ag. N.
T. gracilis Sond. W.

SEIROCOCCUS Grev.

S. axillaris (R.Br.) Grev. S., T.

SCYTOTHALIA Grev.

S. dorycarpa (Turn.) Grev. S.W., S., T.

CYSTOPHORA J.Ag.

C. uvifera (Ag.) J.Ag. S., T.
C. cephalornithos (Lab.) J.Ag. S., T.
C. platylobium (Mert.) J.Ag. S., S.E., T.
C. pectinata (Grev. & Ag.) J.Ag. S.W.
C. xyphocarpa Harv. T.
C. racemosa Harv. S.W., S.
C. scalaris J.Ag. T. (Sonder), N.Z.
C. distenta J.Ag. W. (Sonder), N.Z.
C. retorta (Mert.) J.Ag. W., S., T., N.Z.
C. retroflexa (Labill.) J.Ag. S.W., S., T., E., N.Z.
C. dumosa (Grev.) J.Ag. S., N.Z.
C. siliquosa J.Ag. S.

C. torulosa (R.Br.) J.Ag. S., N.Z.
C. botryocystis Sond. S.
C. grevillei (Ag.) J.Ag. W., S., T.
C. spartioides (Turn.) J.Ag. S., T., E.
C. brownii (Turn.) J.Ag. W., S.
C. monilifera J.Ag. W., S., T., E.
C. thysanoclada J.Ag. W.
C. subfarcinata (Mert.) J.Ag. S.W., S.
C. polycystidea Aresch. S., E.
C. paniculata (Turn.) J.Ag. S., T., E.

CYSTOPHYLLUM J.Ag.

C. onustum (Mert.) J.Ag. W.
C. muricatum (Turn.) J.Ag. W., S., T., E.

CYSTOSEIRA Ag.

C. abrotanifolia Ag. var. *macrocarpa* Kuetz.(Sonder).
C. prolifera J.Ag. W.

SCABERIA Grev.

S. agardhii Grev. S.W., S., T., N.Z.
S. rugulosa J.Ag. S., T.

PHYLLOSPORA Ag.

P. comosa (Labill.) Ag. S.W., S., T., E.

CARPOGLOSSUM Kuetz.

C. confluens (R Br.) Kuetz. S., T.
C. quercifolium (R.Br.) J.Ag. S.W , N.Z.
C. angustifolium (Sond.) J.Ag. W.

Family FUCACEÆ (Lamour.) Kjellm.

HORMOSIRA Endl.

H. banksii (Turn.) Decne. W., S., T., E., N.Z.
H. gracilis Kuetz.
H. sieberi (Bory) Decne. Norfolk I.
H. labillardieri (Bory) Mont.
} Probably varieties of *H. banksii*.

H. nodularia (Mert.) Decne. W.
H. articulata (Forsk.) Zanard. N. (= *Cystoseira articulata* J. Ag.).

MYRIODESMA Decne.

M. serrulatum (Lamour.) Decne. W.
M. leptophyllum J. Ag. S.W.
M. integrifolium Harv. S., T.
M. latifolium Harv. W.
M. tuberosum J. Ag. S.W.
M. quercifolium (Bory) J. Ag. S.W., S., T., N.Z.
M. calophyllum J. Ag. S.

XIPHOPHORA Mont.

X. billardierii Mont. S., T.
X. chondrophylla (R. Br.) Harv. S., T., N.Z.

Family HIMANTHALIACEÆ Kjellm.

HIMANTHALIA Lyngb.

H. (?) *australis* Sond. W.

Family DURVILLÆACEÆ Oltm.

SARCOPHYCUS Kuetz.

S. potatorum (Labill.) Kuetz. S., T.

SPLANCHNIDIUM Grev.

S. rugosum (L.) Grev. S., T., E.

NOTHEIA Bail. & Harv.

N. anomala Bail. & Harv. S., T., N.Z.

Order **TETRASPORINÆ** De Toni.

Family DICTYOTACEÆ (Lamour.) Zanard.

GYMNOSORUS J. Ag.

G. variegatus J. Ag. E.
G. nigrescens (Sond.) J. Ag. W., E.

ZONARIA (Draparn.) J. Ag.

Z. diesingiana J. Ag. S., E., Norfolk I.
Z. crenata J. Ag. W., S.
Z. turneriana J. Ag. W., S., T.

Homœstrichus J. Ag.

H. sinclairii (H. & H.) J. Ag. S., E.
H. stuposus (R. Br.) J. Ag. S.
H. canaliculatus J. Ag. S.
H. spiralis J. Ag. S.W.

Chlanidote J. Ag.

Ch. microphylla (Harv.) J. Ag. S.

Lobophora J. Ag.

L. nigrescens J. Ag. S.

Taonia J. Ag.

T. australasica J. Ag. S.

Padina, Adans.

P. pavonia (L.) Lamour. E., Norfolk I.
P. commersonii Bory. N., W.
P. australis Hauck. N.
P. fraseri (Grev.) J. Ag. W., E.

Spathoglossum Kuetz.

S. cornigerum J. Ag. E.
S. macrodontum J. Ag. N.
S. grandifolium J. Ag. S.

Haliseris Targ.-Tozz.

H. polypodioides (Desf.) Ag. T., E.
H. woodwardia (R. Br.) J. Ag. N.E.
H. muelleri Sond. S., T.
H. acrostichoides J. Ag. S., T.
H. australis Sond. W., N.
H. pardalis Harv. W.
H. crassinervia Zanard. Lord Howe I.
H. plagiogramma Mont. A. (Zanardini), Norfolk I.

Dictyota Lamour.

D. vittarioides J. Ag. S.
D. latifolia J. Ag. S.
D. nigricans J. Ag. S., T.

D. bartayresiana Lamour. N.
D. apiculata J. Ag. S.
D. dichotoma (Huds.) Lamour. E
D. ocellata J. Ag. T., N.Z.
D. prolificans A. & E. S. Gepp E.
D. diemensis Sond. T.
D. sandvicensis Sond. N.
D. fenestrata J. Ag. S.
D. radicans Harv. N.
D. ciliata J. Ag. W.?, Norfolk I
D. robusta J. Ag. S.
D. bifurca J. Ag. S., N.
D. alternifida J. Ag. S., N.
D. furcellata Ag. (Gaudichaud).
D. polyclada Kuetz. W.

PACHYDICTYON J. Ag.

P. furcellatum (Harv.) J. Ag. W., S.
P. minus (Sond.) J. Ag. S.W.
P. paniculatum J. Ag. S.W., S., T

DILOPHUS J. Ag.

D. gunnianus J. Ag. S., T.
D. fasciculatus J. Ag. S., T.
D. tæniæformis J. Ag. W., S.
D. opacus J. Ag. S.
D. wilsoni J. Ag. S.
D. angustus J. Ag. S.
D. marginatus J. Ag. S.
D. fastigiatus (Sond.) J. Ag. W., S.
D. moniliformis J. Ag. W.
D. foliosus J. Ag. S.
D. tener J. Ag. S.

LOBOSPIRA Aresch.

L. bicuspidata Aresch. S.W., S.

Order **PHÆOZOOSPORINÆ** Thuret.

Family CUTLERIACEÆ Zanard.

CUTLERIA Grev.

C. multifida (Sm.) Grev. S. Not listed by De Toni.

Family LAMINARIACEÆ (Bory) Rostaf.

ADENOCYSTIS Hook. & Harv.

A. lessonii Hook. f. & Harv. T., N Z.

ECKLONIA Hornem.

E. radiata (Turn) J. Ag. W., S., T., E., N.Z.
E. lanciloba Sond. S.
E. stenophylla J. Ag. S.

MACROCYSTIS Ag.

M. pyrifera (Turn.) Ag. S., T., S.E.

Family SPOROCHNACEÆ (Reichb.) Decne.

BELLOTIA Harv.

B. eriophorum Harv. S., T.

PERITHALIA J. Ag.

P. inermis (R.Br.) J. Ag. S., T., S.E.
= *Carpomitra inermis* Kuetz.
= *C. siliquosa* J Ag. T.

ENCYOTHALIA Harv.

E. cliftoni Harv. W.

SPOROCHNUS Ag.

S. comosus Ag. W., S., T.
S. herculeus J. Ag. T.
S. radiciformis (R.Br.) Ag. W., S., T., S.E.
S. scoparius Harv. W., S.W.
S. moorei Harv. E.
S. apodus Harv. T.
S. obovatus Kuetz S.
S. sphærocephalus Kuetz. S.
S.(?) *cryptocephalus* Kuetz. S.

Family SPERMATOCHNACEÆ Kjellm.

SPERMATOCHNUS Kuetz.

S. australis Kuetz.

Family STILOPHORACEÆ (Naeg.) DT. et Levi.

STILOPHORA J.Ag.

S. rhizodes (Ehrh.) J.Ag. S., T. Doubtfully identical.
S. australis Harv. T.

Family CHORDARIACEÆ (Ag.) Zanard.

MYRIONEMA Grev.

M. leclancherii (Chauv.) Harv. T.

EUDESME J.Ag.

E. virescens (Carm.) J,Ag. S., T. Doubtfully identical.
E. australis (Harv.) J.Ag. S., T.
(= *Liebmannia australis* Harv.).

BACTROPHORA J.Ag.

B. filum (Harv.) J.Ag. W., S.?
B. vermicularis J.Ag. S., T.
B. nigrescens (Harv.) J.Ag. S., T.
= *Cladosiphon nigricans* Harv.

MYRIOCLADIA J.Ag.

M. sciurus Harv. S., E.

POLYCEREA J.Ag.

P. ramulosa J.Ag. T.

CLADOSIPHON Kuetz.

C. zostericola Harv. S.W., S.

CORYNOPHLŒA Kuetz.

C. cystophoræ J.Ag. S.

LEATHESIA Gray.

L. difformis (L.) Aresch. S., T. Doubtfully identical.

LIEBMANNIA J.Ag.

L.(?) *harveyana* J.Ag. T.

CHORDARIA Ag.

C. cladosiphon Kuetz. S.
=*Cladosiphon chordaria* Harv.

C. dictyosiphon (Harv.) Kuetz. S.
=*Cladosiphon dictyosiphon* Harv.

C. incurvata J.Ag. T.

Family ELACHISTACEÆ Kjellm.

ELACHISTA Duby.

E. australis J.Ag.

Family STRIARIACEÆ Kjellm.

STICTYOSIPHON Kuetz.

S. decaisnei (Hook. f. & Harv.) Murray. T. Doubtfully identical. (=*Nereia australis* Harv.?).

Family ENCŒLIACEÆ (Kuetz.) Kjellm.

PHYLLITIS Kuetz.

P. fascia (Muell.) Kuetz. E.

COLPOMENIA Derb. & Sol.

C. sinuosa (Roth.) Derb. & Sol. W., S., E., N.
=*Asperococcus sinuosus* Bory.

HYDROCLATHRUS Bory.

H. cancellatus Bory. W., S., E., N., Norfolk I.

ASPEROCOCCUS Lamour.

A. bullosus Lamour. W., T.
=*A. turneri* Hook.

A. echinatus (Mert.) Grev. W. (Harvey). Not listed by De Toni.

SPHACELARIA Lyngb.

S. biradiata Asken. S.

S. borneti Hariot. ?

S. pulvinata Hook. f. & Harv. S.

S. divaricata Mont. Torres Sts.

CLADOSTEPHUS Ag.

C. spongiosus (Lightf.) Ag. S., T., E.
C. verticillatus (Lightf.) Ag. S.

STYPOCAULON Kuetz.

S. paniculatum (Suhr) Kuetz. S.W., S., T., E., N.E., N.Z.
=*Sphacelaria paniculata* Suhr.
S. funiculare (Mont.) Kuetz. S., N.Z.

PHLOIOCAULON Geyl.

P. spectabile Reinke. S.

XANTHOSIPHONIA J.Ag.

X. wattsii J.Ag. S.

Family ECTOCARPACEÆ (Ag.) Kuetz.

PYLAIELLA Bory.

P. littoralis (L.) Kjellm. (Grunow).

ECTOCARPUS Lyngb.

E. simpliciusculus Ag. E. (Askenasy).
E. indicus Sond. E. (Askensay).
E. siliculosus (Dillw.) Lyngb. W., S., T.
E. fasciculatus (Griff.) Harv. W., S., T.
E. granulosus Ag. (Kuetzing).
E. sordidus Harv. T.

FLORIDEÆ Lamour.

BANGIOIDEÆ De Toni.

Family BANGIACEÆ (Zanard.) Berth.

BANGIA Lyngb.

B. ciliaris Carm.
Subsp. *pulchella* Harv. S., T.
B. sp. E.

PORPHYRA Ag.

P. woolhousiæ Harv. T.

WILDEMANIA De Toni.

W. laciniata (Lightf.) De Toni. W., S., T., E.

EU-FLORIDEÆ De Toni.

Order **NEMALIONINÆ** Schmitz.

Family HELMINTHOCLADIACEÆ (Harv.) Schmitz.

BATRACHOSPERMUM Roth.

B. moniliforme Roth. S., T.

B. dillenii Bory. T.

=*B. atrum* Harv.

B. vagum Ag. T.

B. sp. E. (Lucas).

GULSONIA Harv.

G. annulata Harv. S., T.

CHANTRANSIA (DC.) Schmitz.

C. polyrhiza (Harv.) De Toni. S.

C.(?) *radicans* (Harv.) De Toni. W.

C.(??) *botryocarpa* (Harv.) De Toni. S W.

All recorded by Harvey under *Callithamnion.*

HELMINTHOCLADIA J.Ag.

H. australis Harv. W.

H. densa (Harv.) Schmitz. S., T.

=*Nemalion insigne* Harv.

HELMINTHORA J.Ag.

H. divaricata (Ag.) J.Ag. W., S.

H. tumens J.Ag. S.

LIAGORA Lamour.

L. orientalis J.Ag., forma. S.

L. viscida (Forsk.) Ag W., prob. S., T.

L. cliftoni Harv.) J.Ag. W., S.

=*Galaxaura cliftoni* Harv.

L. cheyneana Harv. W., S.

L. rugosa Zanard. Norfolk I.

var. *vieillardii* Grun.

L. australasica Sond. W.

Omitted by J. Agardh.

TIAROPHORA J.Ag

T. australis J.Ag. S.

Family CHÆTANGIACEÆ Schmitz.

SCINAIA Bivona.

S. furcellata (Turn.) Bivon. T., N.Z.
S. moniliformis J.Ag. S.

GLOIOPHLŒA J.Ag.

G. scinaioides J.Ag. W.

BRACHYCLADIA Sond.

B. marginata (Soland.) Schmitz. W., E.

GALAXAURA Lamour.

G. umbellata (Esper) Lamour. W.,
=*G. obtusata* Harv.
G. elongata J.Ag. N.E., Norfolk I.
G. collabens J.Ag. S.W.
G. lapidescens (Soland.) Lamour. W.
G. janioides Lamour. ?
G. fasciculata Kjellm. [Okamura, Bot. Mag. 1904.]

CHÆTANGIA Kuetz.

C. lingula Harv. T.
C. flabellatum Harv. T.

Family GELIDIACEÆ (Kuetz.) Schmitz.

BINDERELLA Schmitz.

B. neglecta Schmitz. W.
Included in *Bindera splachnoides* by Harvey.

WRANGELIA Ag.

W. nitella Harv. W.
W. mucronata Harv. S., T.
W. myriophylloides Harv. W., S.
W. velutina Harv. W., S.
W. gunniana J.Ag. T.

W. tenella Harv. W.
W. jeannerettii Hook f. & Harv. T.
W. protensa Harv. S., T.
W. halurus Harv. W., S.
W. verticillata Harv. S.
W. crassa Hook. f. & Harv. W., S., T.
W. wattsii Harv. W., S.
W. abietina Harv. W.
W. clavigera Harv. S.
W. ballioides J.Ag. T.
W. nobilis Harv. S., T.
W. setigera Harv. S., T.
W. penicillata Ag. W. Doubtfully identical.
W. plumosa Harv. S., T., E.
W. princeps Harv. W., S.

GELIDIUM Lamour.

G. rigidum (Vahl) Grev. Norfolk I.
G. australe J.Ag. S.
G. glandulæfolium Hook. f. & Harv. S., T.
G. asperum (Mert.) Grev. S., T.
G. proliferum Harv. W.

PTEROCLADIA J.Ag.

P. lucida (R.Br.) J.Ag. W., S., E., N.Z.
P. capillacea (Gmel.) Born. & Thur. E., Norfolk I.

Order **GIGARTININÆ** Schmitz.

Family ACROTYLACEÆ Schmitz.

ACROTYLUS J.Ag.

A. australis J.Ag. W., S.

PELTASTA J.Ag.

P. australis J.Ag. S.

HENNEDYA Harv.

H. crispa Harv. W.

Family GIGARTINACEÆ Schmitz.

ECTOCLINIUM J.Ag.

E. dentatum J.Ag. T.
E. latifrons J.Ag S.

IRIDÆA Bory.

I. australasica J.Ag S., T.
I. foliifera Harv. T.
=*Rhodoglossum foliiferum* Harv.
I. harveyi J.Ag. T.
=*Rhodoglossum lanceolatum* Harv.
I. polycarpa Harv. T.
=*Rhodoglossum polycarpum* (Harv.) J.Ag.
I. prolifera J.Ag. S., T.
=*Rhodoglossum proliferum* J.Ag.
I. purpurea J.Ag. T.
=*Rhodoglossum purpureum* J.Ag.
I. latissima (Hook. f. & Harv.) Grun. T.?, N.Z.
I. lubrica Suhr. Insufficiently known.

GIGARTINA Stackhouse.

G. brachiata Harv. S., T.
G. aciculifera Zanard. T
G. binderi Harv. T.
G. flabellata J.Ag. S., T
G. disticha Sond. W.
G. pinnata J.Ag. S., T.
G. congesta Zanard. T.
G. livida (Turn.?) J.Ag. S, T.
G. wehliæ Sond. S.
G. ancistroclada Mont. T.
G. circinnalis Zanard. S.
G. pumila Zanard. S.
G. gigantea J.Ag. S., T.
G. radula (Esp.) J.Ag. T.
G. orbicularis Zanard. S.
G. lanceata J.Ag. S.

G. flagelliformis Sond. W.

Perhaps a species of *Rhabdonia* (De Toni).

STENOGRAMMA Harv.

S. interruptum (Ag.) Mont. T.

S. leptophyllum J.Ag. S.

GYMNOGONGRUS Mart.

G. fastigiatus Harv. T.

G. irregularis Zanard. Lord Howe I.

MYCHODEA Harv.

M. terminalis Harv. S., T.

M. membranacea Harv. W., S., T.

M. carnosa Harv. W., S., T.

M. pusilla (Harv.) J.Ag. S.

=*Acanthococcus pusillus* Harv.

M. fastigiata (Harv.) J.Ag. S.

=*Hypnea fastigiata* Harv.

M. hamata Harv. S., T.

=*Acanthococcus ewingii* Harv.

M. compressa Harv. S.

M. nigrescens Harv. S.

M. disticha Harv. T.

M. halymenioides Zanard. Lord Howe I.

M. zanardinii De Toni & Levi. Lord Howe I.

M. foliosa (Harv.) J.Ag. S.

=*Gymnogongrus foliosus* Harv.

M. obtusangula (Harv.) De Toni(?). S.E.

=*Acanthococcus obtusangulus* Harv.

M. gracilaria (Sond.) De Toni(?). S.

=*Acanthococcus gracilaria* Sond.

DICRANEMA Sonder.

D. revolutum (Ag.) J.Ag. W., S.

D. grevillei Sond. W., S.

D. filiforme Sond. W.

D. setaceum Sond. E.

CALLOPHYLLIS Kuetz.

C. obtusifolia J.Ag. S.
C. gigartinoides J.Ag. S.
C. alcicornis J.Ag.
C. cervicornis Sond. S.
C. harveyana J.Ag. S., T.
=*C. obtusifolia* Harv., non J.Ag.
C. marginifera J.Ag. S.
C. ramentacea J.Ag. S.
C. lambertii (Turn.) Grev. W. rare, S., T.
C. coccinea Harv. T. Includes *C. carnea* J.Ag.
C. microcarpa Zanard. T.
C. australis Sond. W.
C. fimbriata Hook. f. & Harv. T.

POLYCŒLIA J.Ag.

P. fastigiata Harv. T.
P. laciniata J.Ag. W.
P. chondroides J.Ag. S.
P. australis J Ag.

CALLYMENIA J.Ag.[=KALLYMENIA].

C. cribrosa Harv. S., T.
C. tasmanica Harv. S., T., E.
C. nitophylloides J.Ag. E.

GLAPHYROMENIA J.Ag.

G. pustulosa J.Ag. S.

MEREDITHIA J.Ag.

M. nana J.Ag. S.
M. polycœlioides J.Ag. S., T.

HORMOPHORA J.Ag.

H. australasica J.Ag. S.

GELINARIA Sond.

G. ulvoidea Sond. S.W.
G. harveyana J.Ag. S.

Family RHODOPHYLLIDACEÆ Schmitz.

CATENELLA Grev.

C. opuntia (Good. & Woodw.) Grev. E.
C. procera J.Ag. E.

MERISTOTHECA J.Ag.

M. tasmanica J.Ag. T.

GLOIOPHYLLIS J.Ag.

G. barkeriæ (Harv.) J.Ag. S.
=*Rhodophyllis barkeriæ* Harv.
G. engelhardtii Reinb. S.

RHODOPHYLLIS Kuetz.

R. bifida (Good. & Woodw.) Kuetz. W.
R. volans Harv. S.W., S
R. blepharicarpa Harv. W.
R. ramentacea (Ag.) J.Ag. S.
=*Calliblepharis ramentacea* J.Ag.
R. membranacea Harv. S., T.
R.? gunnii Harv. S., T.
R. multipartita Harv. S., T.
R. brookeana J.Ag. S.W., S.
R. tenuifolia (Harv.) J.Ag. W.
=*Callophyllis tenuifolia* Harv.
R. goodwiniæ J.Ag. T.
R. hypneoides Harv. S., T.
R. marginalis J.Ag. S.

ERYTHROCLONIUM Sond.

E. angustatum Sond. S.
E. sonderi Harv. W.
E. muelleri Sond. S.
E. pyriferum J.Ag. W.

RHABDONIA Harv.

R. nigrescens Harv. S., T.
R. coccinea Harv. S., T.

R. dendroides Harv. S.
R. charoides Harv. S.
R. verticillata Harv. S., T.
R. globifera (Lamour.) J Ag. W.
R. clavigera J.Ag S.
R. robusta (Grev.) J.Ag. S., E.
=*Solieria australis* Harv.
R. umbellata Zanard. T.
R. mollis Harv. S.
R. racemosa J.Ag. S.
R hamata Zanard. S.
R. patens Harv. W.
R. compressa J.Ag. T.

EUCHEUMA J.Ag.

E. spinosum (L) J.Ag. N.
E. gelatinæ (Esp) J.Ag N.
E. speciosum (Sond.) J.Ag. S.W., T.

ARESCHOUGIA Harv.

A. congesta (Turn.) J.Ag. S.
Includes *A. gracilarioides* Harv. W.
A. laurencia (Hook. & Harv.) Harv. W., S., T.
A. stuartii Harv. S., T.
A. intermedia J.Ag. S.
A. ligulata Harv. W
A (?) *sedoides* Harv. W.

THYSANOCLADIA Endl.

T. costata Harv. W.
T. dorsifera (Ag.) Endl. W.
T. coriacea (Sond.) Harv. W.
T. harveyana J.Ag. W., S.
T. angustifolia J.Ag. W.
T. laxa Sond. S., E.
T. oppositifolia (Ag.) J.Ag. W.

Order **RHODYMENINÆ** Schmitz.

Family SPHÆROCOCCACEÆ (Dum.) Schmitz

PHACELOCARPUS Endl. & Dies.

P. complanatus Harv. S., T.

P. alatus Harv. W., S., T., E.

P. labillardieri (Mert.) J.Ag. W., S., T., N.Z.

P. apodus J.Ag. S.

P. sessilis Harv S.

P. densus Aresch S.

HERINGIA J.Ag.

H. filiformis Harv. W., S.

STENOCLADIA J.Ag.

S. furcata (Harv.) J.Ag. S.

=*Heringia furcata* Harv.

S. cliftoni J.Ag. W.

=*Areschougia conferta* Harv. pars.

S. harveyana J.Ag. W., S.

=*Areschougia conferta* Harv. pars.

S. corymbosa J.Ag. W.

S. ramulosa J.Ag. S.

=*Areschougia dumosa* Harv.

S. sonderiana J.Ag. W.

NIZYMENIA Sonder.

N. australis Sond. S., T.

GELIDIOPSIS Schmitz.

G.(?) *acrocarpa* (Harv.) Schmitz. N.

SARCODIA J.Ag.

S. palmata Sond. N.

S. marginata J.Ag. S.

S. ciliata Zanard. Lord Howe I.

TREMATOCARPUS Kuetz.

T. concinnus (R.Br.) J.Ag. Kent I.

=*Dicurella concinna* (R.Br.) J.Ag.

MELANTHALIA Mont.

M. abscissa (Turn.) Hook. f. & Harv. T.
M. concinna (R.Br.?) J.Ag. S.
M. obtusata (Lab.) J.Ag. S., T.
M. polydactylis J.Ag. E.

CURDIÆA Harv.

C. laciniata Harv. S., T.
C.(?) *meredithiæ* J.Ag. T.
C.(?) *irvineæ* J.Ag. W.

SARCOCLADIA Harv.

S. obesa Harv. S.W.

GRACILARIA Grev.

G. lichenoides (L.) Harv. N.E.
G. lucasii A. & E. S Gepp. E.
G. tænioides J.Ag. N.=*G. lemania* Sond.
G. aculeolata Aresch. S.
G. fruticosa Harv. W.
G. ramulosa J.Ag. S.W.
G. spinescens (Kuetz.) J.Ag. T. Doubtfully identical.
G. secundata Harv. E.
G. harveyana J.Ag. W.
G. furcellata Harv. W.
=*G. confervoides* of Harvey's Synopsis.
G. textorii Suring. E.
G. pannosa (Harv.) J.Ag. W.
=*Calliblepharis preissiana* J.Ag
G. corniculata (R.Br.) J.Ag. S.
G. canaliculata (Kuetz.) Sond. N.E.
G. polyclada Sond. N.E.

CORALLOPSIS Grev.

C. minor (Sond.) J.Ag. N.
C. urvillei (Mont.) J.Ag. N.
C.(?) *umbellifera* Zanard. S.

TYLOTUS J.Ag.

T. obtusatus (Sond.) J.Ag. W., S.
=*Curdiæa obtusata* Harv.

MERRIFIELDIA J.Ag.

M. ramentacea (Ag.) J.Ag. W., S.

HYPNEA Lamour.

H. musciformis (Wulf.) Lamour. W., E.
H. episcopalis Hook. & Harv. W., S., T.
H. valida J.Ag. W., S.
H. seticulosa J.Ag. W., S., T.
H. cenomyce J.Ag. W.
H.(?) *rugulosa* Mont. N.E.

RHODODACTYLIS J.Ag.

R. rubra (Harv.) J.Ag. W.=*Chondria rubra* Harv.
R. bulbosa (Harv.) J.Ag. T.=*Chondria bulbosa* Harv.

ERYTHRONEMA J.Ag.

E. ceramioides J.Ag. S.

Family RHODYMENIACEÆ (Naeg.) J.Ag.

FAUCHEA Bory & Mont.

F. nitophylloides J.Ag. E.
F. coronata (Harv.) J.Ag. S.
=*Callophyllis coronata* Harv.

GLOIODERMA J.Ag.=HOREA Harv.

G. australis J.Ag. S., T.=*Horea polycarpa* Harv.
G. fruticulosum (Harv.) J.Ag. S.
=*Horea fruticulosa* Harv.
G. wilsonis (J.Ag.) De Toni. S.
G. halymenioides (Harv.) J.Ag. W.
=*Horea halymenioides* Harv.
G. tasmanicum Zanard. S., T.
=*Horea speciosa* Harv.

HYMENOCLADIA J Ag.

H. dactyloides (Sond.) J.Ag. W.
=*Gracilaria dactyloides* Sond.
H. gracilarioides J.Ag. W.
=*Gracilaria ramalina* Harv.
H. filiformis J.Ag. W.
H. subulosa J.Ag. S.W.
H. ceratoclada J.Ag. S.
H. ramalina (Harv.) J.Ag. S.W
H. usnea (R.Br.) J.Ag. S.
H. divaricata (R.Br.) Harv. S.W.
H. polymorpha (Harv.) J.Ag. S., T.
=*Rhodymenia polymorpha* Harv.
H. conspersa (Harv.) J.Ag. W., S.
=*Calliblepharis conspersa* Harv.
H. husseyana (J.Ag.) De Toni. S.
=*Chrysymenia husseyana* J.Ag.

STICTOSPORUM Harv.

S. nitophylloides (Harv.) J.Ag. W.
=*Rhodophyllis nitophylloides* Harv.

CORDYLECLADIA J.Ag.

C. furcellata (Harv.) J.Ag. S.
=*Gymnogongrus furcellatus* Harv.

RHODYMENIA Grev.

R. corallina (Bory) Grev. T. Doubtfully identical.
R. foliifera Harv. W., S., T., N.Z.
R. linearis J.Ag. W., S., T.
R. australis (Sond.) Harv. W., S., E.
R. prolificans Zanard. T.
R. stenoglossa J.Ag. S.
R. pinnulata Zanard. T.

EPYMENIA Kuetz.

E. halymenioides J. Ag. S., T.
E.(?) *cuneata* (Harv.) J. Ag. T.
=*Rhodymenia cuneata* Harv.
E. wilsonii Sond. S.
De Toni includes here *E. obtusa* Grev. Pacific forms.
E. membranacea Harv. S., T.

SEBDENIA Berth.

S. ceylanica (Harv.) Heydr. N.E.
S.(?) *gelatinosa* J. Ag. S.
S.(?) *cliftoni* (Harv.) De Toni. W.
=*Halymenia cliftoni* Harv. pars.
S.(?) *kallymenioides* (Harv.) J. Ag. W.
=*Halymenia kallymenioides* Harv.

HALICHRYSIS (Schousb.) Schmitz.

H.(?) *concrescens* (J. Ag.) De Toni. E.
H.(?) *meredithiana* (J. Ag.) De Toni. E.
=*Chrysymenia meredithiana* J. Ag.

CHRYSYMENIA J. Ag.

C.(?) *digitata* (Harv.) J. Ag E.
=*Gloiosaccion* (?) *digitatum* Harv.
C. uvaria (L.) J. Ag. E.
C. obovata Sond. W., S., T., E.
C. brownii (Harv.) J. Ag. W., S., T.
=*Gloiosaccion brownii* Harv.
C. coccinea Harv. T.

BINDERA Harv.

B. splachnoides Harv. W., S.
B. saccata (Harv.) J. Ag. T.
=*Halymenia saccata* Harv.
B. kaliformis J. Ag. S.
B.(?) *ramosa* J. Ag. S.

AMPHIPLEXIA J. Ag.

A. hymenocladioides J. Ag. S.

CHAMPIA Desv.

C. parvula (Ag.) J.Ag. W., S., T., E., N.
C. affinis (Hook. f. & Harv.) J.Ag. W., S , T.
C. obsoleta Harv. S., T.
C. compressa (?) Harv. W., S.
C. tasmanica Harv. W., S., T.

GASTROCLONIUM Kuetz.

G. reflexum (Chauv.) Kuetz. ?Australia (J.Ag.).
G. (?) *zostericolum* (Harv.) J.Ag. W.
=*Lomentaria zostericola* Harv.

CHYLOCLADIA Grev.

C. clavellosa (Turn.) Grev. ?T.(Harv.)
C. monochlamydea J.Ag. S.
C. fruticulosa Reinb. S.
Perhaps=*C. caespitosa* Harv.
C. corynephora J.Ag. S.
C. ramsayana J.Ag. E.
C. gelidioides Harv. E.
?*Chondrothamnion australe* Kuetz. A.
?*Chondrosiphon novæ-hollandiæ* Kuetz. A.

ERYTHROCOLON J.Ag.

E. cliftoni (Harv.) J.Ag. W.
=*Chylocladia cliftoni* Harv.
E. muelleri (Sond.) De Toni. S.
=*Chylocladia muelleri* Harv.

PLOCAMIUM Lamour.

P. hamatum J.Ag. E., Norfolk I.
P. leptophyllum Kuetz. W., S., T., E.
Includes Australian forms recorded as *P. coccineum*(Huds.) Lyngb.
P. preissianum Sond. S.W.
P. angustum (J.Ag.) Hook. f. & Harv. S., T.
P. costatum (J.Ag.) Hook. f. & Harv. W , S., T.

P. gracile J.Ag. T.
P. nidificum (Harv.) J.Ag. W., S.
P. mertensii (Grev.) Harv. W., S., T.
P. procerum (J.Ag.) Harv. W., T.
P. patagiatum J.Ag. S.
P. dilatatum J.Ag. T.

Family DELESSERIACEÆ (Naeg.) Schmitz.

MARTENSIA Hering.

M. speciosa Zanard. Lord Howe I.
M. australis Harv. W., T.
M. elegans Hering W., S., E.
M. denticulata Harv. S.W.
M. gigas Harv. T.

RHODOSERIS Harv.

R. cartilaginea Harv. & Grev. W.

NITOPHYLLUM Grev.

N. pulchellum Harv. W.
N. crispum (Kuetz.) J.Ag. S., T.
N. gunnianum Harv. S., T.
N. cartilagineum Harv. W.
N. proliferum J.Ag. S.
N. monanthos J.Ag. A.(J.Ag.).
N. endivæfolium (Hook. f. & Harv.) J.Ag. S., T.
=*Delesseria endivæfolia* Harv.
N. fallax J.Ag. S.
N. erosum Harv. W., S.
N. pristoideum Harv. S.
N. gattyanum J.Ag. T.
N. ciliolatum Harv. W., E.
N. minus (Sond.) Harv. W.
N. affine Harv. S., T.
N. multipartitum Hook. f. & Harv. S., T.
N. parvifolium J.Ag. S.
M. caulescens J.Ag. S.
N. polyanthum J.Ag. S., T.

N. validum J. Ag. S.
N. curdieanum Harv. S.
N. hymenema Zanard. T.
N. obsoletum Zanard. T.

PLATYCLINIA J.Ag.

P. stipitata (Harv.?) J.Ag. S., T.
P. crozieri (Hook. f. & Harv.) J.Ag. S Doubtfully identical.
P.(?) *purpurea* J.Ag. S.
P. crispata (Harv.) J.Ag. Doubtfully identical.

PACHYGLOSSUM J.Ag.

P. marginiferum J.Ag. W.
P. engelhardtii J.Ag. S.
P. ovale J.Ag. S.
P. husseyanum J.Ag. S.

HERPOPHYLLUM J.Ag.

H. australe J.Ag. S.

HYPOGLOSSUM Kuetz.

Mostly recorded as species of *Delesseria* by Harvey.

H. crispatulum (Harv.) J.Ag. W.
H. spathulatum (Kuetz.) J.Ag. W., E.
=*D. hypoglossoides* Harv.
H. serrulatum (Harv.) J.Ag. E.
H. dendroides (Harv.) J.Ag. W.
H. microdontum J Ag. S.
H. heterocystideum J.Ag. S.
H. revolutum (Harv.) J.Ag. W.
H. undulatum J.Ag. S.W.
H. protendens J.Ag. S.
H. armatum J.Ag. S.
H. marginatum J.Ag. A.(J.Ag.).

CHAUVINIA Harv.

C. coriifolia Harv. W., S.

HETERODOXIA J.Ag.

H. denticulata (Harv.) J.Ag. W.
=*Delesseria denticulata* Harv.

PHITYMOPHORA J.Ag.

P. imbricata J.Ag. S.=*Chauvinia imbricata* Harv.
=*Delesseria rigida* Harv.

APOGLOSSUM J.Ag.

A. ruscifolium (Turn.) J.Ag. W., T.
A. tasmanicum (F.v.M.) J.Ag. T.
=*Delesseria tasmanica* F.v.M.

HEMINEURA Harv.

H. frondosa Harv. S.W., T.
H.(?) *wilsonis* J.Ag. S.

HALICNIDE J.Ag.

H. similans J.Ag. W., T., E.
=*Delesseria lyalli* Harv. pars.

CALOGLOSSA Harv.

C. leprieurii (Mont.) J.Ag. S. T.

SARCOMENIA Sond.

S. miniata (Ag.) J.Ag. E. Doubtfully identical.
S. rhizocarpa Harv. W.
S. mutabilis (Harv.) J.Ag. W., S
S. corymbosa J.Ag. S.
S. dasyoides Harv. S.
S. victoriæ (Harv.) J.Ag. S.
S. dolichocystidea J.Ag. S.
S. tenera (Harv.) J.Ag W., S.
S. hypneoides Harv. W.
S. delesserioides Sond. W., S.

SONDERELLA Schmitz.

S. linearis (Harv.) Schmitz S.
=*Amansia linearis* Harv.

CLAUDEA Lamour.

C. elegans Lamour. W., S., T.

S o n d e r i a F.v.M.

S. bennettiana (Harv.) F.v.M. E.
=*Claudea bennettiana* Harv.

Family BONNEMAISONIACEÆ (Trev.) Schmitz.

L e p t o p h y l l i s J.Ag.

L. conferta (R.Br.) J.Ag. S., T.
=*Cladhymenia conferta* Harv.

P t i l o n i a J.Ag.

P. australasica Harv. S., T.
P. subulifera J.Ag. S., T.

D e l i s e a Lamour.

D. elegans (Ag.) Mont. W., S., T.
D. hypneoides Harv. S., T.
D. serrata Kuetz. T., E.
D. pulchra (Grev.) Mont. W., S., T., E.
D. fimbriata Lamour. A. (Herb. Lamour.).

A s p a r a g o p s i s Mont.

A. delilei Mont. ?Australia.
A. sandfordiana Harv. W.
A. armata Harv. W., S., T., E.

Family RHODOMELACEÆ (Reichb.) Harv.

Subfamily Laurencieæ (Harv.) Zanard.

L a u r e n c i a Lamour.

L. filiformis (Ag.) Mont. W., S., T.
L. forsteri (Mert.) Grev. W., S., T., E.
L. affinis Sond. W.
L. casuarina J.Ag. S.
L. heteroclada Harv. W., S., Norfolk I.
L. dendroidea J.Ag. W., Norfolk I.
=*L. obtusa* var. *majuscula* Harv.
L. rigida J.Ag. N.
=*L. papillosa* var. Harv.
=*L. botryoides* var. *minor* Harv.

L. cruciata Harv. W., S.
L. obtusa (Huds.) Lamour. S., T., E.
L. cymosa Kuetz.
L. tasmanica Hook. f. & Harv. T.
L. botryoides (Turn.) Gaill. S.
L. elata (Ag.) Harv. W., S., T.
L. luxurians J.Ag. W.
=*L. elata* var. *luxurians* Harv.
L. concinna Mont. W., N., Norfolk I.
L. grevilleana Harv. W.

CORYNECLADIA J.Ag.

C. clavata (Sond.) J.Ag. W., S.
=*Chondria clavata* Harv.
C. umbellata J.Ag. W., S.

JANCZEWSKIA Solms-Laubach.

J. tasmanica Falkenb. S., T.

Subfamily CHONDRIEÆ (Kuetz.) Schmitz.

CLADURUS Falkenb.

C. elatus (Sond.) Falkenb. S.W.
=*Rytiphlœa elata* Harv.

MASCHALOSTROMA Schmitz.

M. fastigiatum Falkenb. S.
=*Alsidium* ? *comosum* Harv.

ACANTHOPHORA Lamour.

A. dendroides Harv. S.W.
A. orientalis J.Ag. N.

CŒLOCLONIUM J.Ag.

C. umbellula (Harv.) Reinb. W., S.
=*Chondria umbellula* Harv.
C. verticillatum (Harv.) J.Ag. W., S., T.
=*Chondria verticillata* Harv.

C. opuntioides (Harv.) J. Ag. W., S.
=*Chondria opuntioides* Harv.
C. incrassatum J. Ag. S., T.

DOLICHOSCELIS J. Ag.

D. clavifera J. Ag. S., T.
D. disticha J. Ag. S.
D. gracilipes J. Ag. S.

CHONDRIA Ag.

C. fusifolia Hook. f. S., T.
C. lanceolata Harv. S.W.
C. arborescens J. Ag. S.
C. foliifera (J. Ag.) Falkenb. S.
C. ovalifolia J. Ag. S.
C. curdieana Harv. ms. S.
C. corallorhiza J. Ag. W.
C. succulenta (J. Ag.) Falkenb. W., S.
C. debilis Harv. W., S., T.
C. harveyana J. Ag. T.
=*Chondria dasyphylla* Harv. pars.
C. cartilaginea J. Ag. A.

Subfamily POLYSIPHONIEÆ (Kuetz.) Schmitz & Falkenb.

LOPHURELLA Schmitz.

L. periclados (Sond.) Schmitz. S., T.
=*Rhodomela periclados* Sond.
L. hookeriana (J. Ag.) Falkenb. S.

FALKENBERGIA Schmitz.

F. vagabunda (Harv.) Falkenb. S.(?), T.
=*Polysiphonia vagabunda* Harv.
F. rufolanosa (Harv.) Schmitz. S.W.
=*Polysiphonia rufolanosa* Harv.

POLYSIPHONIA Grev.

Oligosiphonia J. Ag.

P. roeana Harv. W.

P. *mollis* Hook. f. & Harv. W., S., T.
P. *succulenta* Harv. T.
P. *abscissa* Hook. f. & Harv. S., T.
P. *laxa* Harv. T.
P. *crassiuscula* Harv. T.
P. *implexa* Hook. f. & Harv. S.W.
P. *sphacelarioides* J.Ag. S.
P. *infestans* Harv. S.W.
P. *ferulacea* Suhr. W., T.
P. *blandi* Harv. S.
P. *hookeri* Harv. S., T.
P. *longissima* J.Ag. S.
P. *hystrix* Hook. f. & Harv. W., S., T.
P. *mallardiæ* Harv. W., S., T.
P. *daveyæ* Reinb. S.

Polysiphonia J.Ag.

P. *forcipata* Harv. W.
=P. *forfex* Harv.
P. *frutex* Harv. S., T.
P. *fuscescens* Harv. S., T.
P. *cancellata* Harv. W., S., T.
P. *aurata* Harv. S.W.
P. *atricapilla* J.Ag. S.W.
P. *virgata* (Ag.) Spreng. W.?
P. *rutilans* Kuetz. A. Not well known.
P. *dasyoides* Zanard. T.
P. *flavescens* Zanard. T.
P. *spinuligera* Zanard. T.
P. *macrartha* Zanard. T.
P. *gelidii* Zanard. Lord Howe I.
P. *amœna* Sond. S.
P. *cæspitula* Sond. S.
P. *angustissima* Kuetz. S.
P. *argus* Kuetz. S.

DIGENEA Ag.

D. *simplex* (Wulf.) Ag. N.

TOLYPIOCLADIA Schmitz.

T. glomerulata (Ag.) Schmitz. A. (Gaudichaud).

BRYOCLADIA Schmitz.

B. ericoides (Harv.) Schmitz. T.
=*Polysiphonia ericoides* Harv.

PITYOPSIS Falkenb.

P. tasmanica (Sond.) Falkenb. T.
=*Acanthophora tasmanica* Sond.

CHIRACANTHA Falkenb.

C. arborea (Harv.) Falkenb.
=*Acanthophora arborea* Harv. T.
C. valida (J.Ag.) Falkenb.
=*Polysiphonia valida* J.Ag. W., S.

Subfamily PTEROSIPHONIEÆ Falkenb.

APHANOCLADIA Falkenb.

A. delicatula (Hook. f. & Harv.) Falkenb. E.
=*Rytiphlœa delicatula* H. & H.

POLLEXFENIA Harv.

P. pedicellata Harv. W., S., T.
P. lobata (Lamour. ?) Falkenb. S., T.
=*Jeannerettia lobata* Hook. f. & Harv.
P. crispata (Zanard.) Falkenb. S.
P. crenata J.Ag. S.
P. nana J.Ag. S.

DICTYMENIA Grev.

D. harveyana Sond. S., T.
D. interstincta J.Ag. W., S.
D. tridens (Mert.) Grev. W.
D. sonderi Harv. W.
D. angusta J.Ag. W., S.
D. spinulosa Kuetz. S.W.
D. myriacantha Kuetz. T.

SYMPHYOCLADIA Falkenb.

S. marchantioides (Harv.) Falkenb. N.E.

PTEROSIPHONIA Falkenb.

P. pennata (Roth.) Falkenb. A.(Harvey). Doubtfully identical.

Subfamily PACHYCHÆTEÆ De Toni.

CHAMÆTHAMNION Falkenb.

C. schizandrum Falkenb. W., S.
=*Polysiphonia nigrita* Sond.

Subfamily LOPHOTHALIEÆ Schmitz & Falkenb.

BRONGNIARTELLA Bory.

B. australis (Ag.) Schmitz. W., S., T.
=*Polysiphonia cladostephus* Mont.
B.(?) *patersonis* (Sond.) De Toni. S., T.
=*Polysiphonia spinosissima* Harv.
B. strobilifera (J.Ag.) Schmitz. S.
B. sarcocaulon (Harv.) Schmitz. W., T.
=*Dasya sarcocaulon* Harv.
B. feredayæ (Harv.) De Toni. T.=*Dasya feredayæ* Harv.
B.(?) *disticha* Falkenb. S.

LOPHOCLADIA Schmitz.

L. harveyi (Kuetz.) Schmitz. W.=*Dasya lallemandi* Harv.

LOPHOTHALIA Kuetz.

L. verticillata (Harv.) Kuetz. T.
=*Dasya verticillata* Harv.
L. hormoclados J.Ag. S., T.=*Dasya hormoclados* J.Ag.

DOXODASYA Schmitz.

D. bolbochæte (Harv.) Falkenb. S., T.
=*Dasya bolbochæte* Harv.
D. lanuginosa (J.Ag.) Falkenb. S.
D. lenormandiana (J.Ag.) Schmitz. S.
=*Dasya lenormandiana* J.Ag.

Subfamily POLYZONIEÆ Schmitz.

EUZONIELLA Falkenb.

E. incisa (J.Ag.) Falkenb. S., T.
=*Polyzonia incisa* J.Ag.
E. flaccida (Harv.) Falkenb. W., S.
=*Polyzonia flaccida* Harv.
E. harveyana (Decaisne) Falkenb.
=*Polyzonia harveyana* Decaisne.

LEVEILLEA Decaisne.

L. jungermannioides (Mart. & Hering) Harv. W., N.E., Norfolk I.
=*L. schimperi* Decaisne.
L. pectinata Decaisne.

POLYZONIA Suhr.

P. elegans Suhr. S.W. Doubtfully identical.

CLIFTONÆA Harv.

C. pectinata Harv. W., S.
C. semipennata (Lamour.) J.Ag. S

Subfamily HERPOSIPHONIEÆ Schmitz & Falkenb.

DIPTEROSIPHONIA Schmitz & Falkenb.

D. dendritica (J.Ag.) Falkenb. S.
=*Polysiphonia dendritica* J.Ag
D. prorepens (Ag.) Falkenb. S.W.
=*Polysiphonia prorepens* J.Ag.

HERPOSIPHONIA Naegeli.

H. rostrata (Sond.) Falkenb. W.
=*Polysiphonia rostrata* Sond.
H. pectinella (Harv.) Falkenb. S.W.=*P. pectinella* Harv.
H. versicolor (Hook. f. & Harv.) Falkenb. W., S., T.
=*P. versicolor* Hook. f. & Harv.
H. monilifera (Hook. f. & Harv.) Falkenb. T.
=*P. monilifera* Hook. f & Harv.

H. prorepens (Harv.) Schmitz. S.W.=*P. prorepens* Harv.
H. filipendula (Harv.) Falkenb. W., S.=*P. filipendula* Harv.

HERPOPTEROS Falkenb.

H. fallax Falkenb. S., T.

LOPHOSIPHONIA Falkenb.

L. prostrata (Harv.) Falkenb. W.
=*Polysiphonia prostrata* Harv.
L.(?) *neglecta* (Harv.) De Toni S.W.=*P. neglecta* Harv.
L.(?) *calothrix* (Harv.) De Toni. S.W.=*P. calothrix* Harv.

Among HERPOSIPHONIEÆ De Toni includes

Polysiphonia scopulorum Harv. W.
P. pecten Aresch. S.

Subfamily RYTIPHLŒEÆ (Decaisne) Kuetz.

PROTOKUETZINGIA Falkenb.

P. australasica (Mont.) Falkenb. W., S.W.
=*Rhodomela australasica* Mont.

KUETZINGIA Sond.

K. canaliculata (Grev.) Sond. W.
K. angusta Harv. W.
K. pectinella (Harv.) Falkenb. W.
=*Dictymenia pectinella* Harv.

AMANSIA Lamour.

A. kuetzingioides Harv. W., S.
A. dietrichiana Grunow. E.
A. daemelii (Sond.) J.Ag. N.E.
=*Vidalia daemelii* Sond.
A. pumila (Sond.) J.Ag. N.E.
=*Vidalia pumila* Sond.
A. mammillaris Lamour. A. (Lamour.)
A. pinnatifida Harv. S.W.

ENANTROCLADIA Falkenb.

E. axillaris Falkenb. S.W.
E. robinsonii (J. Ag.) Falkenb. Norfolk I.

RYTIPHLŒA Ag.

R. aculeata Ag. W. =*R.*(?) *spinulosa* Harv.
R. compressa J. Ag. W.
R. merrifieldii J. Ag. W.
R. umbellifera J. Ag. Australia ?(J. Ag.).

VIDALIA Lamour.

V. fimbriata (R. Br.) J. Ag. N.E.
V. spiralis Lamour. W.
V. cliftoni Harv. W.
V. intermedia J. Ag. W.
V. gregaria Falkenb. S.W.

OSMUNDARIA Lamour.

O. prolifera Lamour. W., S.W.
=*Polyphacum proliferum* Ag.
O. intermedia (J. Ag.) De Toni. W.
=*P. intermedium* J. Ag.

NEURYMENIA J. Ag.

N. fraxinifolia (Mert.) J. Ag. W.
=*Dictymenia fraxinifolia* J. Ag.

LENORMANDIA Sond.

L. hypoglossum J. Ag. S.W.
L. marginata Hook. f. & Harv. T.
L. chauvinii Harv.
L. muelleri Sond. S.
L. spectabilis Sond. W., S.W.
L. pardalis J. Ag. S.
L. prolifera (Ag.) J. Ag. S., T.
=*Rytiphlœa simplicifolia* Harv.
L. smithiæ (Hook. f. & Harv.) Falkenb. S., T.
=*Polyphacum smithiæ* Hook. f. & Harv.

Subfamily Heterocladieæ Decaisne.

Trigenea Sond.

T. australis Sond. & Lehm. W., S.
=*Rhodomela trigenea* Harv.
T. umbellata J.Ag. S.

Heterocladia Decaisne.

H. australis (Decne.). W.

Micropeuce J.Ag.

M. strobiliferum J.Ag. S.

Subfamily Rhodomeleæ Falkenb.

Rhodomela.

R. preissii Sond. W.
R. erinacea J.Ag. W.

Subfamily Bostrychieæ Falkenb.

Holotrichia Schmitz.

H. comosa (Harv.) Schmitz. W.
=*Alsidium ? comosum* Harv.

Wilsonæa Schmitz.

W. dictyuroides (J.Ag.) Schmitz. S.
=*Dasya dictyuroides* J.Ag.

Bostrychia Mont.

B. mixta Hook. f. & Harv. E.
B. wardii Harv. E. Doubtfully identical with the Tongan form.
B. simpliciuscula Harv. S.
=*B. rivularis* Harv. Phyc. Austr. Pl. 176B.
B. harveyi Mont. S., T.

Family CERAMIACEÆ (Bonnemaison) Naegeli.

Subfamily Spermothamnieæ Schmitz.

Lejolisia Bornet.

L. aegagropila J.Ag. S.

SPERMOTHAMNION Aresch.

S. turneri (Mert.) Aresch. T. Doubtfully identical.
S. cymosum (Harv.) De Toni. W.
=*Callithamnion cymosum* Harv.

Subfamily GRIFFITHSIEÆ Schmitz.

GRIFFITHSIA Ag.

G. gunniana J.Ag. T.
G. ovalis Harv. S.W.
G. flabelliformis Harv. T.
G. monilis Harv. W., S., T.
G. crassiuscula Ag. A.(Mus. Paris).
G. teges Harv. W.
G. thyrsigera (Thwait.) Grun. W. Norfolk I.
G. gracilis Harv. T.

Subfamily MONOSPOREÆ Schmitz.

BORNETIA Thuret.

B. binderiana (Sond.) Zanard. S.W.
=*Griffithsia binderiana* Sond.
B.(?) *antarctica* (Hook. f. & Harv.) De Toni. T.
=*Griffithsia antarctica* Hook. f. & Harv.
B.(?) *meredithiana* J.Ag. T.

MONOSPORA Solier.

M. australis (Harv.) J.Ag. W.
=*Corynospora australis* Harv.
M. gracilis (Harv.) J.Ag. W., S.
=*Corynospora gracilis* Harv.
M. arachnoides (Harv.) J.Ag. T.
=*Corynospora gracilis* Harv.
M. flabelligera (Harv.) Schmitz. W.
=*Callithamnion flabelligerum* Harv.
M.(?) *licmophora* (Harv.) De Toni. W., S.
=*Callithamnion licmophorum* Harv.
M.(?) *griffithsioides* (Sond.) De Toni. S., T.
=*Griffithsia setacea* Harv. quoad Austr. Spec.

M.(?) *elongata* (Harv.) De Toni. S., T.
=*Callithamnion elongatum* Harv.

PLEONOSPORIUM Naeg.

P.(?) *comatum* (J.Ag.) De Toni. S., T.

Subfamily CALLITHAMNIEÆ (Kuetz.) Schmitz.

CALLITHAMNION Lyngb.

C. fastigiatum Harv. T.
C. multifidum Harv. W.
C. corymbosum (Sm.) Lyngb.
C. laricinum Harv. W., S., T.
C. spinescens Kuetz. W.
C. ramulosum Sond. W.
C. aculeatum Harv. W.
C. muelleri Sond. S.
C. pulchellum Harv. W., S.
C. angustatum Hook. f. & Harv. T.
C. pusillum Harv. W.
C. longinode Harv. S.
C. ovuligerum Asken. S.

SEIROSPORA Harv.

S (?) *byssoides* (Arnott) De Toni. T.

Subfamily SPONGOCLONIEÆ Schmitz.

SPONGOCLONIUM Sond.

S. fasciculatum J.Ag. S.
S. brounianum (Harv.) J.Ag. W.
=*Callithamnion brounianum* Harv.
S. wollastonianum (Harv.) J.Ag. S.W.
=*Callithamnion wollastonianum* Harv.
S. wilsonianum J.Ag. S.
S.(?) *latissimum* (Hook. f. & Harv.) De Toni. T.
=*Callithamnion latissimum* Hook. f. & Harv.
S. angustatum (Hook. f. & Harv.) De Toni. T.
=*C. angustatum* Hook. f. & Harv.

S.(?) *violaceum* (Harv.) De Toni. T.=*C. violaceum* Harv.
S. scopula (Harv.) De Toni. W.=*C. scopula* Harv.
S. scoparium J.Ag. S., T.
S.(?) *paradoxum* (Harv.) De Toni. S., T.=*C.*(?) *paradoxum* Harv.
S. dasyurum (Harv.) J.Ag. S.=*C. dasyurum* Harv.
S.(?) *crispulum* (Harv.) De Toni. W.=*C. crispulum* Harv
S.(??) *debile* (Harv.) De Toni. W.=*C. debile* Harv.

HALOPLEGMA Mont.

H. preissii Sond. W., S., T.

Subfamily WARRENIEÆ Schmitz.

WARRENIA (Harv. ms.) Kuetz.

W. comosa Harv. T.
=*Callithamnion comosum* Harv.

Subfamily PTILOTEÆ Cramer.

EUPTILOTA Kuetz.

E. articulata (J.Ag.) Schmitz. W., S., T.=*Ptilota aculeata* J.Ag.
E. coralloidea (J.Ag.) Kuetz. W., S., T. =*P. coralloidea* J.Ag.
E. jeannerettii (Harv.) Schmitz. S , T.=*P. jeannerettii* Harv.

RHODOCALLIS Kuetz.

R. elegans Kuetz. S., T.=*Ptilota rhodocallis* Harv.

PTILOTA Ag.

P. hannafordii Harv. S.

Subfamily DASYPHILEÆ Schmitz.

DASYPHILA Sond.

D. preissii Sond. W., S.

MUELLERENA Schmitz.

M. wattsii (Harv.) Schmitz. S.=*Crouania wattsii* Harv.
M.(?) *agardhiana* (Harv.) De Toni. S.W.
=*Crouania agardhiana* Harv.
M.(?) *insignis* (Harv.) De Toni. S., T.=*Crouania insignis* Harv.

PSILOTHALLIA Schmitz.

P. striata (Harv.) Schmitz. W., S.=*Ptilota striata* Harv.
P.(?) *siliculosa* (Harv.) Schmitz. W., S.W.=*Ptilota siliculosa* Harv.

Subfamily CROUANIEÆ Schmitz.

BALLIA Harv.

B. callitricha (Ag.) Mont. W., S., T.
B. robertiana Harv. S., T.
B. mariana Harv. S.
B. scoparia Harv. S., T.
B hamulosa J.Ag. S.

ANTITHAMNION Naegeli.

A. verticale (Harv.) J.Ag. W., S.=*Callithamnion verticale* Harv.
A. horizontale (Harv.) J.Ag. W.=*C. horizontale* Harv.
A. armatum (J.Ag.) De Toni W.=*C. armatum* J.Ag.
A.(?) *hanowioides* (Sond.) De Toni. W., S.=*C. hanowioides* Sond.
A. plumula (Ellis) Thur. S., T.=*C. plumula* Lyngb.
A. nodiferum J.Ag. S.=*C. nodiferum* J.Ag.
=*C. simile* Harv. pars.
A. nigrescens J.Ag. S.
A. dispar (Harv.) J.Ag. S., T.=*C. dispar* Harv.
A. gracilentum (Harv.) J.Ag. W., S.=*C. gracilentum* Harv.
A.(?) *australe* (J.Ag.) De Toni.=*C. australe* J.Ag.
A. divergens (J.Ag.) De Toni. S., T.=*C. cruciatum* Harv.
A. mucronatum (J.Ag.) De Toni. W., S., T.=*C. mucronatum* J.Ag.
A.(?) *preissii* (Sond.) De Toni. W.=*C. preissii* Sond.
A.(?) *delicatulum* (Harv.) De Toni. S.W.=*C. delicatulum* Harv.

CROUANIA J.Ag.

C. gracilis J.Ag. T.
C. australis (Harv.) J.Ag. W., S., T.
=*C. attenuata* var. *australis* Harv.
C. muelleri Harv. S.
C. vestita Harv. W., S.W.

LASIOTHALIA Harv.

L. hirsuta Harv. W., S.

L.(?) *plumigera* (Harv.) De Toni. S.
=*Callithamnion plumigerum* Harv.

L.(?) *formosa* (Harv.) De Toni. S.=*C. formosum* Harv.

L.(?) *superbiens* (Harv.) De Toni. S.=*C. superbiens* Harv.

GATTYA Harv.

G. pinnella Harv. W., S.

PTILOCLADIA Sond.

P. pulchra Sond. W., S.

Subfamily SPYRIDIEÆ J. Ag.

SPYRIDIA Harv.

S. biannulata J. Ag. S., T.=*S. filamentosa* Harv. pars.

S. breviarticulata J. Ag. N.

S. spinella Sond. W., Norfolk I.
=*S. filamentosa* Harv. pars.

S. opposita Harv. W., S., T.

S. prolifera Harv. W.

S. nobilis J. Ag. S.

S. wilsonis J. Ag. S.

S. squalida J. Ag. S.

S. dasyoides Sond. S.

BRACEBRIDGIA J. Ag.

B. australis J. Ag. S.

HALIACANTHA J. Ag.

H. incrustans J. Ag. S.

Subfamily CERAMIEÆ (Dumort.) Schmitz.

CERAMIUM Wiggers.

C. macilentum J. Ag. S.

C. repens Harv. S.

C. ramulosum Hook. f. & Harv. S., T.

C. fastigiatum Harv. W., S.
C. australe Sond. W.
C. cliftonianum J.Ag. W.
C. tenuissimum (Lyngb.) J.Ag. W.
C. puberulum Sond. W., S.
C. miniatum Suhr. W., S., E.
C. stichidiosum J.Ag. T.
C. pusillum Harv. W., S.
C subcartilagineum J.Ag. S., T.=*C. rubrum australe* Harv.
C. divergens J.Ag. T.
C. deslongchampii Chauv. T.(?) (Harvey).
C. monacanthum J.Ag. T.
C. isogonum Harv. W., S., T.
C. nodiferum J.Ag. S.
C. nobile J.Ag. S., T.
C. gracillimum Griff. & Harv. S., T.
C. æquabile J.Ag. S., T.
=*C. diaphanum* Harv. quoad Austr. sp.
C. torulosum J.Ag. T.
C. excellens J.Ag. W., S., T.
C. clavulatum Ag. W., S., E.=*Centroceras clavulatum* Mont.
C. cinnabarinum (Gratel.) Hauck. S.
=*Centroceras cinnabarinum* J.Ag.

Subfamily Episporieæ Schmitz.

Episporium Moebius.

E. centroceratis Moeb. W.

Incertæ sedis.

Thamnocarpus Harv.

T. gunnianus Harv. W., S., T.
T. harveyanus J.Ag. T.
T. penicillatus (Harv.) J.Ag. S.=*Callithamnion penicillatum* Harv.
T.(?) *glomeruliferus* J.Ag W., S.

Order CRYPTONEMINÆ.

Family CRYPTONEMIACEÆ.

SCHIZYMENIA J.Ag.

S. bullosa Harv. W.

NEMASTOMA J.Ag.

N. comosum Harv. S.
N. feredayæ Harv. S., T.
N. palmatum Harv. T.

HALYMENIA Ag.

H. floresia Ag. W., S.
H. lacerata Sond. N.E.
H. muelleri Sond. W.
Prob.=*Nemastoma gelinarioides* Harv.
H. chondricola Sond. W.
H. pusilla Sond. W.
H. plana Zanard. S.
H. speciosa Zanard. T.

POLYOPES J.Ag.

P. constrictus J.Ag. W., S.

GRATELOUPIA Ag.

G. gigartinoides Sond. S.
G. prolifera J.Ag. T.
G. dubia Zanard. T.
G. filicina Ag. E.
G. australis J.Ag. S., E.

PRIONITIS J.Ag.

P. microcarpa J.Ag. W., S.
P. obtusa Sond. N.E.

CRYPTONEMIA J.Ag.

C. decipiens Harv. W.
C. elata Harv. W.
C. undulata Sond. W., S., N E.
C. capitellata Sond. N.E.

THAMNOCLONIUM Kuetz.

T. claviferum J.Ag. S., T.
T. codioides J.Ag. S.
T. dichotomum J.Ag. E.
T. proliferum Sond. W.
P. lemannianum Harv. W.
T flabelliforme Sond. W.
T. spongioides J.Ag. W.
T. harveyanum Sond. W.

Family SQUAMARIACEÆ.

CRUORIA Fries.

C. australis Harv. W.

PEYSSONNELIA Decaisne.

P. coccinea J.Ag. W.
P. novæ-hollandiæ Kuetz. S.
P. gunniana J.Ag. T., E.
P. australis Sond. W., S., T.
P. multifida Harv. W., E.
P. rubra (Grev.) J.Ag. Norfolk I.

RHODOPELTIS Harv.

R. australis Harv. W.

Family CORALLINACEÆ.

MELOBESIA Aresch.

M. membranacea Lamour. N.E.
M. farinosa Lamour. W., N.
M. pustulata Lamour. E, Norfolk I.
M. patena Hook. f. & Harv. S.
M. granulata Kuetz. N.E.
M. lichenoides Ellis. Norfolk I.

LITHOTHAMNION Philippi

L. darwini Aresch. S.W.

MASTOPHORA Decaisne.

M. lamourouxii Decne. W., S.
M. plana Sond. W.
M. canaliculata Harv. S., T.

AMPHIROA Lamour.

A. australis Sond. W.
A. galaxauroides Sond. W.
A. anceps Lamour. W., E., Norfolk I.
A. ephedræa Lamour. W., S., E.
A. gracilis Harv. S.W., N.E.
A. elegans Hook. f. & Harv. S., T.
A. charoides Lamour. W., S., T.
A. similis Sond. W.
A granifera Harv. S.
A. intermedia Harv. W.
A. stelligera Lamour. W., S., T.
A. nobilis Kuetz.
A. tasmanica Sond. T.

CHEILOSPORUM Aresch.

C. pulchellum Harv. W.
C. sagittatum Aresch. E.

ARTHROCARDIA Aresch.

A. wardii Aresch. S., E.
A. mallardiæ Aresch. S., T.

JANIA Lamour.

J. micrarthrodia Lamour. W., S., T., Norfolk I.
var. *tenuissima* Sond. W., N.
J. rubens Lamour. N.E.
J. fastigiata Harv. W., S., N.E.
J. affinis Harv. W.
J. pedunculata Lamour. E.
J. natalensis Harv. E.
J. compressa Lamour.

CORALLINA Lamour

C. officinalis L. T.
C. pusilla Sond. S.W., S.=*C. nana* Lenormand.
C. chilensis Decne. E., Norfolk I.
C. clavigera Kuetz. S.
C. pilifera Lamour. W., S.
C. cuvieri Lamour. W., S., T., E.
var. *crispata* Aresch. S., T.
var. *subulata* Aresch. W., S.
var. *denudata* Sond. S.
Includes *C. rosea* Lamour.
C. granifera Ell. & Soland. ?
C. calliptera Kuetz.
C. plumifera Kuetz.

Corrigendum—p. 21, line 28, for *Galauxaura* read *Galaxaura*.

INDEX OF GENERA AND SUBGENERA.

Acting on the President's suggestion, it was unanimously resolved, on the motion of Mr. C. Hedley, seconded by Dr. Woolnough, that the very heartiest congratulations of the Members assembled at the Annual General Meeting on behalf of the Society, should be tendered to Professor and Mrs. David on the safe return of the former with the other members of the Expedition led by Lieutenant Shackleton, together with an expression of their appreciation of the admirable manner in which the Expedition had carried out its arduous work, and the magnificent results achieved.

As Mr. Lucas had received an official invitation to represent the Society at the Lord Mayor's Reception on Thursday night, 1st prox., it was resolved also, with the concurrence of the President elect, that the retiring President be deputed to deliver the Society's congratulations and message to Prof. David at the Lord Mayor's gathering.

On the invitation of the President, Rev. Joseph Capra, Doctor of Science and Agriculture, a visitor from Milan, briefly addressed the Meeting. The speaker said that, as some impromptu remarks on forestry questions, made on his arrival in Sydney, had attracted notice, he thought he could most suitably utilise the invitation extended to him by stating what repentant Italy was attempting to do in the way of reafforestation. Legislation was now in force prohibiting, under severe penalties, the cutting down of a single tree without the knowledge and sanction of an inspector, whose duty it was to take cognizance of, and deal with, these matters. In addition to what the Italian Government was directly doing in the way of planting and forming nurseries. it was earnestly striving to create a national sentiment, by special efforts to diffuse knowledge; and to make tree-planting a national practice, by affording encouragement and the means for doing it. The aid of the children, too, was enlisted in the work of planting trees at specially arranged annual festivals—Arbor Days; they were taught also to take note of the progress and welfare of the young trees planted in preceding years, with interest and joy. In this way Italy was evincing the true repentance which manifests itself in action as well as in feeling. From what he had seen and heard during his visit, he thought that he was not mistaken in venturing to say that Australia might learn some useful lessons from the experience and practice of his fatherland.

Mr. J. H. Campbell, Hon. Treasurer, presented the balance sheet for the year 1908, duly signed by the Auditor, Mr. F. H. Rayment, F.C.P.A., Incorporated Accountant; and he moved that it be received and adopted, which was carried unanimously.

The Linnean Society of New South Wales.

GENERAL ACCOUNT.

Balance Sheet at 31st December, 1908.

LIABILITIES.

	£	s.	d.
Capital: Amount received from Sir William Macleay during his life-time	14,000	0	0
Further Sum bequeathed by his Will £6,000, less Probate Duty, £300 ...	5,700	0	0
	£19,700	0	0
Income Account at 31st Dec., 1907 ...	43	19	5
	£19,743	19	5

ASSETS.

	£	s.	d.	£	s.	d.
Investments: Loans on Mortgage	14,700	0	0			
Fixed Deposits, Commercial Banking Co. of Sydney, Ltd.	5,000	0	0			
				19,700	0	0
Current Account, Commercial Banking Co. ...				43	19	5
				£19,743	19	5

Audited and found correct, and Securities produced.

F. H. RAYMENT, F.C.P.A., Incorporated Accountant.

Sydney, 15th February, 1909.

J. H. CAMPBELL, Hon. Treasurer.

INCOME ACCOUNT, year ended 31st December, 1908.

Dr.

	£ s. d.	£ s. d.
To Salaries and Wages ...		478 0 0
,, Printing (Publications) ...	359 1 5	
,, Illustrations	82 15 8	
		441 17 1
,, Ground Rent	48 0 0	
,, Rates	13 12 5	
,, Insurance	7 13 8	69 6 1
,, Repairs to Building ...		12 12 6
,, Bank Charges	0 11 7	
,, Postage, Telegrams, Advertising, and Petties ...	42 12 4	
,, Telephone Rent	5 0 0	
,, Accountancy Fee	5 5 0	
,, Printing (sundries), Stationery, &c....	4 8 3	
,, Maintenance Fee, Sir Wm. Macleay's Grave ...	1 10 0	
		59 7 2
		1,061 2 10
,, Balance to 1909		43 19 5
		£1,105 2 3

Cr.

	£ s. d.	£ s. d.
By Balance at 31st Dec., 1907		85 16 10
,, Subscriptions—		
Arrears	9 9 0	
1908	100 16 0	
1909	6 6 0	
		116 11 0
,, Entrance Fees		10 10 0
,, Interest on Investments		770 10 0
,, Sales (including 100 copies of Proceedings purchased by Government)		121 14 5
		£1,105 2 3

Audited and found correct, and Securities produced.

F. H. Rayment, F.C P.A., Incorporated Accountant.

J. H. Campbell, Hon. Treasurer.

Sydney, 15th February, 1909.

BACTERIOLOGY ACCOUNT.

Balance Sheet at 31st December, 1908.

Liabilities.	£	s.	d.	Assets.	£	s.	d.
Capital: Amount bequeathed by Sir William Macleay, £12,000, less Probate Duty £600	11,400	0	0	Investments: Loans on Mortgage ...	13,350	0	0
Accumulated Interest ordered by Council to be added to Capital	1,600	0	0	Cash in Bank, Current Account	507	0	4
Interest invested	350	0	0				
	13,350	0	0				
Income Account at 31st December, 1908	507	0	4				
	£13,857	0	4		£13,857	0	4

Dr. INCOME ACCOUNT, year ended 31st December, 1908. Cr.

	£	s.	d.	£	s.	d.		£	s.	d.	£	s.	d.
To Salary and Wages	426	0	0				By Balance at 31st Dec., 1908				423	1	9
,, Ground Rent	16	0	0				,, Interest on Investments				534	0	0
,, Rates	4	10	9				,, Tuition Fees	£30	0	0			
,, Insurance	1	5	4				,, Less Bacteriologist's proportion	20	0	0			
,, Apparatus, Journals, and Printing	1	12	6								10	0	0
,, Petty Cash (Bacteriologist)	6	0	0										
				460	1	5							
,, Balance to 1909				507	0	4							
				£967	1	9					£967	1	9

Audited and found correct, and Securities produced.

F. H. Rayment, F.C.P.A., Incorporated Accountant.

Sydney, 15th February, 1909.

J. H. Campbell, Hon. Treasurer.

LINNEAN MACLEAY FELLOWSHIPS' ACCOUNT

Balance Sheet at 31st December, 1908.

Liabilities.

		£	s.	d.
Capital: Amount bequeathed by Sir William Macleay, £35,000, less £1,750 Probate Duty...		33,250	0	0
Balance from Income Account capitalised in terms of bequest or available for such purpose—				
To 31st Dec., 1907	£4,115 16 11			
On 31st Dec., 1908	660 12 3			
		4,776	9	2
		£38,026	9	2

Assets.

	£	s.	d.	£	s.	d.
Investments: Loan on Mortgage	33,250	0	0			
Inscribed Funded Stock at 4%, due August, 1909 ...	1,020	0	0			
Fixed Deposits, Commercial Banking Co. of Sydney Ltd.	3 095	0	0			
				37,365	0	0
Cash in Bank, Current Account				661	9	2
				£38,026	9	2

INCOME ACCOUNT, year ended 31st December, 1908.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Salaries of Linnean Macleay Fellows ...	800	0	0	By Interest on Investments	1,460	12	3
,, Amount transferred to Capital Account	660	12	3				
	£1,460	12	3		£1,460	12	3

Audited and found correct, and Securities produced.

F. H. Rayment, F.C.P.A., Incorporated Accountant.

Sydney, 15th February, 1909.

J. H. Campbell, Hon. Treasurer.

No nominations of other Candidates having been received, the President declared the following elections for the current Session to be duly made :—

President : C. Hedley, F.L.S.

Members of Council (to fill five vacancies) : Richard T. Baker, F.L.S., W. W. Froggatt, F.L.S., A. H. S. Lucas, M.A., B.Sc., Thomas Steel, F.C.S., F.L.S., Fred. Turner, F.L.S., &c.

Auditor : [To be appointed at a Special General Meeting to be held on 24th November, 1909.]

A telegram from Prof. David expressing his regret at being unable to be present, and his best wishes to all, was handed in and read from the Chair.

In moving a vote of thanks to the retiring President for his interesting address, Professor J. T. Wilson made appreciative reference to the conspicuous ability and discernment which Mr. Lucas had displayed in the discharge of his Presidential duties throughout a very interesting and important period of the Society's history. The motion was carried with acclamation; Mr Lucas replied.

ORDINARY MONTHLY MEETING.

WEDNESDAY, MARCH 31st, 1909.

Mr. C. Hedley, F.L.S., President, in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting (November 25th, 1908), amounting to 42 Vols., 261 Parts or Nos., 92 Bulletins, 11 Reports, 46 Pamphlets, and 26 Maps, received from 128 Societies, &c., and 3 Individuals, were laid upon the table.

NOTES ON THE GEOLOGY OF THE MT. FLINDERS AND FASSIFERN DISTRICTS, QUEENSLAND.

By H. I. Jensen, D.Sc., formerly Linnean Macleay Fellow of the Society in Geology.

(Plates i.-vi.)

Mount Flinders is a rugged peak attaining an altitude of 2,240 feet, and situated about 11 or 12 miles S.S.E. of the town of Ipswich, Queensland. Surrounding the main peak there are a number of smaller cones and rugged rocks, most of which represent remnants of former parasitic vents or smaller foci of eruption which encircled the large volcano.

The rocks composing the main peak are felspar-porphyry, trachyte, trachyte-breccia, tuffs, and occasionally a little andesite, dacite, and dacite-breccia. The smaller cones consist likewise of trachyte-breccia and andesite, and some of the most rugged rocks (see fig 8) consist of a plug of trachyte or trachy-rhyolite. The andesite is not by any means abundant, and may be looked upon as merely a more basic phase of the trachyte. It occurs here and there interbedded with or overlying trachyte-flows or sheets of breccia.

It is noteworthy that the conical mountains are usually composed of breccia, with more or less of basic trachyte, dacite and andesite; and, further, they are characterised by better soil (usually of a red or brown colour), and a thicker vegetation; patches of vine-scrubs occur on them.

The Physiography of the surrounding Region.

To the north of Mount Flinders lies the Coalfield area of Ipswich and Bundamba, which has been described in a Report by Mr. W. E. Cameron, B A.* This area forms part of a series of

* Geology of the West Moreton or Ipswich Coalfield. Geol. Surv. of Queensland, Rep. 1899.

sandstones, conglomerates and shales to which the name "Ipswich Formation" has been given; and which, from the fossil plants contained in it, has been referred to the Upper Trias-Jura. The whole series has been greatly faulted and folded, the folding in some cases being due to compression of trough-faulted blocks. Here and there basalts have burst through the fissures and covered considerable areas. Such is the case at Booval, near Ipswich. In Ipswich proper a hill known as Limestone Hill is capped with a deposit of secondary limestone and siliceous sinter. These substances are leached out of a mass of decomposed basalt and basaltic tuff, which has been extruded from a curved fissure. In other places basaltic cones of considerable height may be seen, as Mt. Forbes or Walker, about 15 miles S.S.W. of Ipswich. This mountain intrudes the Walloon Series, the newest of the Ipswich Formation, and flows from Mt. Walker cap the Walloon Series over considerable areas. To the west and south-west of Ipswich the Coal Measures are not so faulted and tilted as at Ipswich. These Coal Measures form the Walloon Series, which is separated, according to Rands and Cameron, by a probable line of fault running N.E.-S.W from Fernvale in the direction of the Flinders Mountain group. Towards the N.W., this fault forms the border between the Palæozoic rocks of the Parishes of Burnett and Sahl* and the Walloon Series. The Brisbane River, although it meanders into the Ipswich Formation, in places has a tendency to follow this fault through some part of its course. After the Brisbane River has swerved to the east, flowing north of the Pine Mountain inlier, the fault continues in its original direction separating Pine Mountains from the Walloon Series, and further to the S.W. Deebing Creek practically flows parallel to the fault-line.

This fault is of importance in the discussion of the geology of Mt. Flinders because the mountains of the Mt. Flinders group lie to the east of it in the intensely faulted and crushed strip of country which lines the eastern side of that fault. In this strip

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* See Cameron's map No.2 of the Ipswich Beds.

the dip is generally S.W. or W.S.W. at moderate or high angles. To the west of the fault most of the observed dips are at low angles (Walloon Series). If this fault were absolutely linear, it would pass almost through the summit of Mt. Flinders, but, from the tendency to strong westerly dips west of Mt. Flinders, it is concluded that the main fault swings round to follow a more meridional direction.

The Walloon Series are so slightly inclined that outcrops are seldom met with. The Coal beds, which are mined near Ipswich, probably occur here at considerable depth. The preservation over this area of the newer beds of the Ipswich Formation is due to their downthrow, and the older Series has been exposed east of the great fault-line by faulting and overthrust-folding. In the Parishes of Thorn, Normanby, and Fassifern, west of Mt. Flinders, the Coal Measures belong to the Walloon Series and are extensively covered with basalt-flows. The faulting, which is so extensive in the Ipswich district, probably dies out to the south of Mt. Flinders, or at all events it becomes less pronounced; it appears to me to be due to the fracturing of an anticline by faults parallel to its axis. South and south-east of Mt. Flinders a number of rather flat-topped hills exist, which I take to be remnants of the anticline. These hills consist essentially of sandstone with or without capping of dark trachyte-lava or basalt, and they form in part—*i.e.*, north of Mt. Flinders—the watershed between the tributaries of the Bremer River and those of the Logan River.

Still further to the south-east we get to the Beaudesert district; here, too, we meet with Coal Measure sandstones, often altered to hard quartzites by doleritic intrusions, and extensive areas are capped with basalt-flows. The basalts and dolerites around Beaudesert are covered with rich black soil which was originally partly scrub-land and partly forest. The chief forest-trees on the formation are *Eucalyptus tereticornis* and *E. maculata*; on the hills also are *E. crebra*, *E. melanophloia*, *E. hemiphloia* and *E. tesselaris*.

The geology of this region has, to some extent, been discussed by W. H. Rands in his Report upon the Albert and Logan Districts, 1889. In that Report Mr. Rands refers to a fine sanidine-trachyte, "apparently interbedded with" the Ipswich Coal Measures, near Walton Station. This is the only place in the district where Mr. Rands met with trachytes. On my own visit to the district I unfortunately did not see the locality, for neither do the maps show, nor could anybody I asked at Beaudesert tell me of, such a place as Walton Station. The occurrence referred to by Mr. Rands is probably not a truly interbedded sheet but a fine-grained sill.

Although the main object of my investigation in the present paper is Mt. Flinders and the immediate neighbourhood, yet on the present trip I extended my researches to a review of the interesting volcanic rocks of the Fassifern district, of which I hope later to make a closer study. In all my field work I have had the benefit of the advice of Mr. Wearne, B.A., Principal of the Ipswich Technical College, who is an excellent geologist and is intimately acquainted with the district.

The most fertile part of the Fassifern District is known as the Fassifern Scrub, which has a diameter of about eight miles. This area was originally covered with a dense jungle of vine-scrub, though now most of it is under cultivation; and the strange thing about it is that the underlying rock is essentially trachyte. The trachyte-masses intrude sandstone of a very calcareous nature, and are associated with trachyte-tuffs and were followed by eruptions of andesitic basalts. The basalts of the adjoining districts are forest-covered, the chief timbers being Ironbark (*E. melanophloia* and *E. crebra*), and Blue Gum (*E. tereticornis*). We have, therefore, at Fassifern the inverse of the usual order of things. Generally the basalts have scrub and the trachytes forest, but here the trachytes have scrub and the basalts forest.

The dense vegetation of the trachytes of the Fassifern Scrub is due to three main causes :—

1. There is a mixture of soils derived from alkaline trachyte, from calcareous sandstone of the Walloon Coal Measures, and from the numerous dykes of basalt which intrude the trachytes.

2. Decomposition of the rock is faster than usual, because of its rather coarse texture, the fair average rainfall (30 inches per annum), and the abundance of springs in the trachyte area.

3. Much of the soil is derived from tuffs and breccias

Absence of scrub on the basalts here is due to the same cause as in other western localities, viz., the rainfall is too irregular to sustain a scrub in the absence of springs.

The volcanic rocks of the Fassifern Scrub are all Post-Triassic and probably Post-Cretaceous. There seems to have been an old series of dolerites anterior to the trachytes, but I have not satisfied myself on this point. The remaining links of the sequence, viz.—(1) Trachyte, later (2) Andesite, and still later (3) Basalt.—I have found satisfactory evidence for.

All the volcanic rocks of the Fassifern Scrub may be looked upon as belonging to the denuded remnant of one great volcano, a fraction of which remains in Mt. French. The latter consists of massive columnar trachyte; some of the columns reach a length uninterruptedly of some 250 feet. The columns of the North Peak are vertical, and this part of the mountain is probably a flow.

To the W.S.W. of Mt. French lies Mt. Edwards, which likewise consists of columnar trachyte. South of Mt. Edwards lie the peaks of Mt. Greville and Mt. Alford, both consisting of trachyte and quartz-trachyte. All these are isolated peaks, the plugs of independent denuded volcanoes. On these mountains and on the summit of Mt. French the vegetation is of a poor forest-type as in the Glass House Mountains. The trees which follow the trachytes are Ironbarks (*E. crebra* and *E. melanophloia*) and Moreton Bay Ash (*E. tesselaris*). On the poor, very siliceous sandstones which occur west and south-west of the Fassifern Scrub, the forest-trees consist of Spotted Gum (*E. maculata*), Blue Gum (*E. tereticornis*), Ash (*E. tesselaris*), Wattle (chiefly *Acacia decurrens*), Box (*E. hemiphloia*). On the richer flats and on hills which are cut by dykes, occasional Bloodwoods (*E. corymbosa*), occasional Dogwood-trees (*Jacksonia scoparia*), and, near watercourses, Apples (*Angophora intermedia* and *A. subvelutina*), Ironbark (*E. crebra*), and *Callistemon* or Bottle-Brush.

To the south of the area in which all these trachytic mountains occur, and lying between this area and the McPherson Range, there are numerous steep peaks, and ridges, and ranges which are of rhyolitic composition, according to Mr. Wearne, who has shown me beautiful rhyolites and obsidians from this district. The rhyolitic mountains comprise the McPherson Range, Mt. Maroon, the Maroon Range, Mt. Barney, and Mt. Toowoonan (the last-mentioned may be composed of trachyte). It would seem that the period of eruption which gave trachytes in the Fassifern District, gave rhyolites in the McPherson Range area. Basalts have followed in both areas.

From Engelsburg, in the Fassifern District, I visited, accompanied by Messrs. Wearne, McGrath, and Johns, the Little Liverpool Range. We ascended the range along the Old Warwick Road, and reached a point between Spicer's Peak and Mt. Mitchell, about 23 miles from Engelsburg. A section showing the structure of the range (not to scale) is given in fig. 1.

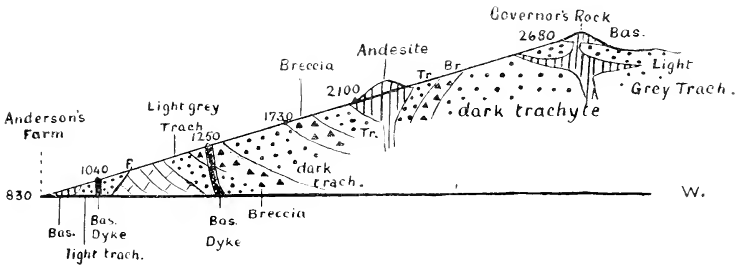

Fig. 1.—Diagrammatic representation of the formations met with in ascending the Little Liverpool Range along the Old Warwick Road

The whole range is apparently due to a gigantic trachyte fissure-eruption, which has emitted flows of light grey trachyte, sheets of breccia and tuff, dark trachytes and trachy-andesites. Later eruptions of a more localised and less intense nature emitted andesite, which in some places has burst through the trachyte. Still later, eruptions simultaneous with those which emitted the enormous flows of basalt on the Darling Downs, gave rise to dykes and sills, intruding also the trachyte. These Darling Downs basalts have been blocked on the east by the trachytic range. That the focus of the volcanic activity is near the core of the range is seen by beds of breccia containing blocks up to 24 inches in diameter, occurring half-way up. The forest on the breccia-formation consists of *Casuarina*, Bloodwood (*E. corymbosa*), Blue Gum (*E. tereticornis*), Stringybark (*E. acmenioides*), Tallow-wood (*E. microcorys*), Moreton Bay Box (*Tristania conferta*), Apple (*Angophora subvelutina*), Ironbark (*E. melanophloia*), and Grass-tree (*Xanthorrhœa*).*

The culminating peaks of the range, like Spicer's Peak, Mt. Mitchell, Mt. Cordeaux, Mt. Huntley, Mt. Roberts, &c., are apparently of trachytic composition; and almost all the eastern fall of the range is essentially trachyte, but the western fall and the top of the range (excluding the peaks) have considerable patches of basalt. I have good reason to believe that the whole of the Little Liverpool Range, from Wilson's Peak to the Rosewood District, is mainly trachytic; and that this range is built up along a great fault running N.N.W.-S.S.E., following a line which, in Triassic and Cretaceous times, played a similar part to that probable fault running from Dubbo to Narrabri in New South Wales. During Triassic times sedimentation took place mainly to the east of this line; during Cretaceous time subsidence took place to the west of it, with the result that sedimentation took place mainly over this part of the country. In Post-Cretaceous times a great horizontal uplift took place, or perhaps, as Suess would have it, a negative movement of the sea; this was followed by faulting, which led to the formation of a trough in which the Ipswich Formation is preserved. This trough would be encompassed between two faults, A and D, the one, D, separating the subsided area from the Brisbane schists, and A, separating the area from the stable or elevated Darling Downs. (Figs. 2 and 3.) Had the downthrow of the Ipswich Measures been earlier, we should have expected more Cretaceous sediments deposited over the Ipswich Measures.

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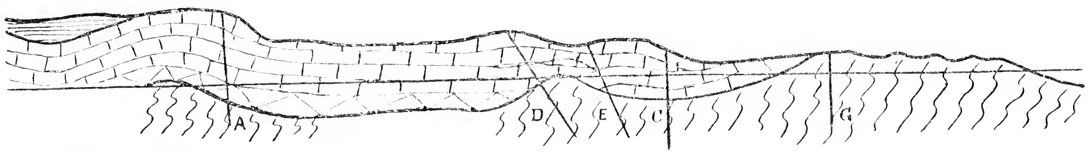
* I am indebted to Mr. McGrath for the identification of many of the forest-trees.

Fig. 2.



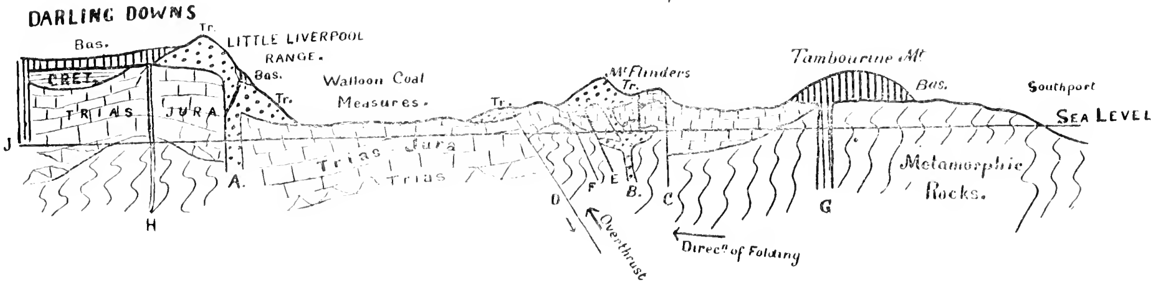


Fig. 3.

Fig. 2—Ideal section from the Darling Downs to the sea, after the upheaval following the period of Mesozoic sedimentation and before the period of faulting and volcanic extravasation. A, D, E, C, G represent the chief lines of weakness where faults subsequently formed. Hatching as in fig. 2.

Fig. 3—Ideal section from the Downs to the sea. A, H, J, B and G are volcanic pipes; D, F, E, C, faults.

Cretaceous sediments occur occasionally in the Ipswich Coal Measure area, but only as very small localised lenticular patches which represent deposits formed in lagoons or river-channels. In Cretaceous times the drainage must have been from east to west. Further faulting, as between C and D, has led to the compression of some parts, leading to the intense folding and overthrusting at Ipswich.

Some processes of this kind must have given rise to the structures observed between the Brisbane schists and the Darling Downs.

Another point worthy of comment is that, with the exception of the Brisbane River, all the watercourses in S.E. Queensland roughly follow the structural lines, such as faults, anticlinal axes, &c., and run N.N.W.-S.S.E. or N.-S., or more rarely N.N.E.-S.S.W. Such is the case with the Brisbane and Bremer Rivers above Ipswich, the Logan and Albert, Deebing Creek, the Stanley River, &c., &c. These streams are all subsequent. A somewhat recent elevatory movement in part of this area has effected certain changes in the drainage; Mr. Wearne informs me that old river-channels filled with sand and gravel sometimes interrupt the working of a coal seam.

Most of the valley of the Bremer River presents the features of mature erosion. Likewise the Teviot Valley is mature, except for a small part where it receives Woollaman Creek and Undallah Creek as tributaries. Here it flows through hilly country, and I consider this region to have been slowly and recently elevated, river-erosion having kept pace with elevation. It is a strange thing, which cannot be explained on other suppositions, that the watershed between the Bremer and Teviot is almost in old age, whilst all the Teviot's tributaries flow for a short distance through rugged hilly country, even those which rise in the perfectly mature area. It is evident that the Brisbane River is a fairly young stream as regards its lower course. It is only just entering upon its mature stage; but many of its important tributaries are mature. The nature of the beds through which they flow partly accounts for this, the tributaries carving their valleys in soft sandstone, the main stream in hard schists. There is an immense amount of valuable work to be done in working out the history of the drainage of South-eastern Queensland.

So much for the physiography of the districts around Mt. Flinders. The main facts to be gleaned may be summarised as follows : —

1. Mt. Flinders is an isolated trachytic volcano.

2. It rises out of inclined and highly faulted Trias-Jura formation, which it has broken through. The intense folding observed in this belt of country is due to the crushing of the faulted portions.

3. Trachyte becomes more abundant as the south-western border of the Ipswich Formation is reached near the New South Wales border, viz., in the Little Liverpool Range.

4. The trachytes here probably fill a gigantic fissure. Evidence pointing this way was found in the presence, in the trachyte, of masses of sandstone altered to quartzite, and often these blocks of included quartzite show slickensided structure on the surface.

Detailed Account of Mount Flinders.

The main peak of Flinders consists, as show in figs. 4-5, of a plug of felspar-porphyry, which is surrounded and capped by trachytic breccias. These occur on the mountain all round the summit at a height of 1,800 feet, and the breccia-zone is marked all round

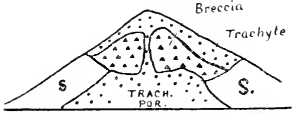


Fig. 4—Sketch-section of Mt. Flinders as before erosion.

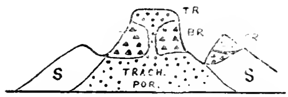


Fig. 5—Sketch-section of Mt. Flinders after erosion.

by a circlet of large caves. In one of these caves, on the south side of the mountain, fibrous alum fills the joint-cracks, and occurs as an excrescence on the rock. This is, probably, because the rock (breccia) is rich in sulphur, which by some process is being oxidised, and is reacting with the products of decomposition of the felspar. Right on top occurs the normal alkaline trachyte.

This, as well as breccia, may also be found on all the spurs from the main plug. In the immediate vicinity of the mountain occur several smaller knobs, which clearly represent remnants of flows from the top of Mt. Flinders, which have been isolated by streams undermining them by working into the underlying breccias. As the map shows (plan fig. 2), the Flinders Peak is surrounded by numerous smaller mounts, such as Ivory's Knob, Mt. Goolman, Mt. Blaine, Stafford's Knob, Green Knob, Mt. Elliott and Dwyer's Knob. Each of these peaks was an independent focus of eruption.

Ivory's Knob, as the photograph shows, (Pl.v. fig.1) is a rugged pinnacle. On examination it was found to consist of breccia made up of fragments of trachyte, sandstone, chert, &c., cemented firmly by dykes and stockworks of trachyte-lava which had been injected into the breccia. Rhyolitic trachytes must have flowed from the crater of this volcano, and a remnant of a breccia-sheet, capped with a flow of spherulitic obsidian, occurs in Kelly's paddock, Selection 218, Parish of Goolman.

Stafford's Knob is simply a plug of rhyolitic trachyte. A little tuff occurs near its base.

Dwyer's Knob I did not get to, but its structure appears identical with that of Stafford's Knob.

Mt. Goolman I did not go to, but it appears similar to and intermediate in structure between Mt. Flinders and Mt. Blaine.

All the foregoing have a poor grey soil and wretched forest vegetation.

Mt. Blaine is largely covered with scrub. This is due to the fact that this mountain is mainly composed of breccia, covered with flows of amygdaloidal andesite. The core is, however, trachytic. The andesite and quartz-dacite are merely a basic phase of the trachyte, and I could find no evidence to show whether they were erupted early or later than the true trachyte. The soil of Mt Blaine is brownish, and Pine (*Callitris* ?) is a characteristic timber.

The Green Mountain has a similar conical appearance and brown soil; the vegetation on it is, however, less luxuriant; and, as far as I could judge, its component rocks were breccia and dark ægirine trachyte-flows.

Mt. Elliott and similar smaller cones present close resemblance to Green Knob.

All these plugs may best be considered as parasitic vents of the great volcano of Flinders. Thin flows from this group must have extended six or seven miles to the west, for isolated remnants overlying sandstone with petrified wood, occur near Peak Crossing. Dykes also occur, as on Selections 44 and 47. Basalts appear to cap trachyte in places near Peak Crossing, but they have been emitted from a different focus of eruption. No true basalt occurs on the tops or slopes of the Flinders mountains. The trachytes mentioned by Rands as occurring between Logan Village and Beaudesert, near Walton Station, are probably genetically connected with those of Mt. Flinders, which cannot be 20 miles distant.

Between Mt. Flinders and Mt. Blaine, near Perry's house (Selections 103 and 107) numerous faults were noticed in the creek banks (Sandy Creek). Sudden changes of dip occur, but the dominant direction of dip is west. The abundance of faults in this locality is noteworthy (fig. 2).

Supplementary Notes.—In figs. 2-3 I have tried to offer an explanation of the geological structure of South-east Queensland, which has metamorphic rocks fringing the coast and the late Mesozoic rocks forming a tableland 2,000 feet high inland. On the Darling Downs we have the Upper and Lower Cretaceous, and the whole Jurassic and Triassic underlying the Tertiary (Pliocene ?) basalt-flows. East of the Darling Downs over the Ipswich Formation no Cretaceous beds occur, except a few lenticular patches of small area, containing a few fossil fishes and fossil plants of fresh-water origin. These small isolated outliers are always of such shape that it is evident that they are deposits formed in lagoons and river-beds. It is quite possible that they are of Post-Cretaceous age.

It appears, therefore, that in Cretaceous time there was land east of the position of the Little Liverpool Range, and sea to the west of it. Yet that old sea-area stands now 2,000 feet higher than the old land-area. How can we explain this phenomenon? Evidently at the end of the Cretaceous period the Cretaceous sea dried up, and its basin was uplifted, the expansion of Triassic and Jurassic sediments aiding to bring about vertical uplift.

Possibly, as the sketch (figs, 2-3) suggests, the Ipswich and Walloon Measures participated in the uplift and folding, which, however, were greatest over the Downs basin, where sedimentation was thickest. Why now have we the Walloon coal-measures, which, on the Darling Downs, immediately underlie the Cretaceous, lying about 2,000 feet lower in the Ipswich area than in the Downs, and dipping west in under the Darling Downs? Either the Walloon measures are very thick, exceeding 2,000 feet, and a considerable thickness has been removed by erosion east of the range, or a Post-Cretaceous fault has lowered the whole area over which they now outcrop by about 2,000 feet.

The first hypothesis I object to on the following grounds:—

(1) I believe that 2,000 feet is an overestimate of the thickness of these beds.

(2) If this area was land in the Cretaceous, as it appears to have been, the slight angle of dip of the beds of the Walloon series, and the continuation of apparently the same beds higher up in the Darling Downs tableland, and the existence of what are looked upon as Cretaceous deposits in patches formed by aggradation, are facts implying that the area formed in Cretaceous times a lowlying coastal plain fringing Cretaceous sea, and that it consequently did not suffer extensive Cretaceous erosion. But in early Tertiary times a fault developed and the country west of it was progressively raised, and that east of it depressed. Simultaneously volcanic outpourings overspread the plains on both sides of the fault. Thus we have trachytes, trachyte-tuffs, basalts, and andesites capping the Walloon coal-measures in many places. These lavas probably commenced to be erupted in Eocene times, and have protected the underlying Trias-Jura from Tertiary erosion. If Tertiary erosion had been very pronounced, it is doubtful whether any Eocene tuffs would have been preserved to

tell the tale of volcanic eruptions. Only the plugs of extinct volcanoes would have been left.

Being a low, inland plain, situated between the Palæozoic coastal hilly country and the upraised Darling Downs, the Ipswich-Fassifern district was protected from extensive Tertiary erosion.

We see, then, that the country east of the Darling Downs has probably been depressed by early Tertiary trough-faulting. The Ipswich area was greatly fractured and overthrust. The area covered by the Walloon coal-measures subsided in a block, and, being practically a broad, belted coastal plain at the outset (in the late Cretaceous), and being by progressive subsidence lowered to the new base-level before its configuration could be interfered with by eastward-flowing streams, it has preserved an old and mature appearance which is only disturbed by Tertiary lava-domes, and Tertiary folding in the Ipswich beds.

Petrology.

1. *Pyroclastic Rocks.*—In the Little Liverpool Range a trachyte-agglomerate or breccia, with boulders up to many tons in weight, is a rock of common occurrence. Basic tuffs and breccias have also been observed in places. At Mount Flinders and on the slopes of Mt. Blaine considerable areas are covered with a breccia intermingled with lava which has a brecciated structure, having swept up fragments of the underlying breccia. Some of the breccias are distinctly trachytic, others appear andesitic.

The lavas interstratified with the breccias on Mt. Flinders and Mt. Blaine look like the dacites of Bankfoot House in the Glass House Mountains. Quartz and oligoclase are common constituents in them. Zeolites, pseudobrookite, magnetite, and ilmenite also occur. In addition, the usual trachyte-felspars, sanidine and anorthoclase, are quite common, and the groundmass is generally a dark, often black, cryptocrystalline to glassy lava, frequently with microspherulitic structure well developed in it.

Globulites, margarites, axiolites, crystallites, and spherulites are very common structures in these hypohyaline brecciated lavas.

The breccias and tuffs contain an abundance of characteristic boomerang-shaped, bone-and-knuckle, and dumbbell-shaped glass-fragments.

These pyroclastic rocks were all formed subsequently to the period of extrusion of the comendites and trachytes, and at the commencement of the andesitic and dacitic eruptions.

Fl.15. Loc.: Alum Cave, Mt. Flinders.

Light white to greyish brecciated rock which has bluish stains (smaltite) and bright pinkish-red (erythrite) stains due to cobalt. In handspecimen it is seen to be made up of fragments of all sizes imbedded in an aphanitic groundmass.

Under the microscope the fine groundmass may be seen to be composed of fragments of crystals and microlites firmly interlocked. Nepheline is an abundant constituent, as is also orthoclase (or anorthoclase). This part of the rock is a tuff.

On examining the inclusions some are found to consist of tuff and breccia, others of cryptocrystalline, pseudospherulitic lava. The latter exhibits micropœcilitic fabric; numerous areas which, in plain light, seem to be made up of a dense felt of minute crystallites, extinguish together; the reason obviously being that certain areas which have a felspar-composition but are crowded with minute inclusions, have crystallised out either primarily or by devitrification. As these areas have consolidated under pressure, they do not possess crystalline outlines, but the abundant inclusions present, nevertheless, give them the appearance of being divided up into crystals.

Felspar is the main component of both tuffy and lava-portions. Next in amount we have the feebly birefringent to isotropic minerals which consist of globulites, crystallites, &c., together with areas of felspathoid. Differentiation between them is rarely possible. Next in abundance we have the nepheline which can be recognised as such. It occurs as hexagonal and prismatic sections showing cleavage at 60°, and characteristic refractive index and double refraction. Next we have a clear colourless or faint bluish mineral with the R.I. of topaz, and a D.R. of about 0·030. It occurs associated with decomposing nepheline and felspar. It shows an hexagonal cleavage like nepheline. It is in all probability katapleite. In still smaller amount we have a yellow amorphous mineral which stands in medium relief, and has a very low double refraction. This does not show the peg-structure of melilite, yet it may be melilite. It may also be perhaps eudialite. Cancrinite occurs associated with nepheline and katapleite, and is distinguished from the latter by its low index of refraction. Complex twinning is another characteristic of the katapleite. Nosean appears also to be present, associated with the same decomposition-products.

This rock contains veins of alum. The alum is derived from the decomposition of some mineral like nosean, or from some sulphosilicate like microsommite.

From the nature of the contained minerals we must call this rock "phonolitic breccia."

2. *The Trachytes.* (*a*) Comendites.—Rocks belonging to this family occur abundantly on Mt. Flinders, Mt. Blaine, and surrounding pinnacles, and on Mt. French and on the Little Liverpool Range. The following has been selected for detailed description.

Fl.17. Macroscopically, a fine-grained, aphanitic, white rock, occurring as gigantic vertical columns extending to the summit of Mt. French.

Microscopic examination : texture, holocrystalline, microcrystalline with orthophyric fabric. Composition : the essential minerals are felspar and quartz. The minor constituents comprise arfvedsonite, secondary magnetite, peropkite(?), chalcedony, and tridymite(?). The felspar is chiefly of the isometric or almost isometric form, though some is prismatic. It is the most abundant mineral, amounting to about 70 % of the rock. It possesses the usual properties of sanidine, and is partly idiomorphic and partly allotriomorphic. Quartz comes next in order of abundance. It occurs chiefly in the form of idiomorphic prisms, hexagonal in section, and forms about 20 % of the rock. There is also present allotriomorphic quartz and chalcedony. The chalcedony occurs chiefly as irregular masses infilling cavities which were originally miarolitic. Each mass has a brownish rim, and a faint yellow interior which frequently has a fibrous radial or banded structure. The brownish rim has a double refraction of about 0·020, and a higher refractive index than canada balsam, hence probably contains a variety of serpentine. The yellow portion is sometimes isotropic, sometimes feebly birefringent in a spherulitic manner, being optically an aggregate of spherulites. Its refractive index is higher than that of canada balsam. It consists undoubtedly of chalcedonic silica and opal. That these secondary minerals infill cavities is shown by the fact that the quartz and felspar of the rock always present idiomorphic faces towards them. Included in the chalcedony masses there frequently occur minute coin-shaped or hexagonal plates which are perfectly clear, colourless, and almost isotropic, and have a very low refractive index. This mineral is tridymite, and it occurs also in small amount in other parts of the rock. Soda-amphibole amounts to less than 5 %. It is of a dull, slaty-green colour, possesses the characteristic amphibole cleavage, and occurs in allotriomorphic corroded crystals which, in general, present straight edges in the cleavage-direction. The extinction angle with the cleavage on the face b(𝔠 : c') is 14°. Pleochroism is strong and well marked. On sections showing only one cleavage, the pleochroism may be from blue-black to green, or from green to yellowish-brown. On sections perpendicular to the prism-zone, the colour changes from olive-green to opaque blue-black. As 𝔞 lies near the c' axis, the absorption-scheme works out to

𝔠(deep greenish-blue) > 𝔟(olive-green) > 𝔞(greenish-yellow).

Occasionally small arfvedsonite grains occur together with dusty magnetite in the chalcedony masses.

Name : Orthophyric Comendite.

Soil : this rock yields a poor sandy grey soil.

Silica percentage : the SiO_2 percentage in this rock was estimated and found to be 76·12.

Closely allied in composition to the comendites are various rocks belonging to the orthophyres and pantellarites. To these classes belong the rocks now about to be described.

Fl. 1. Loc.: Stafford's Rock, near Mt. Flinders.

Handspecimen: reddish-banded rock, aphanitic and showing flow-structure.

Microscopic texture: microcrystalline phenocrysts are imbedded in a microfelsitic (microaphanitic) base, partly isotropic and partly birefringent. The texture is minutely hiatal-porphyritic and micro-vitrophyric. The base predominates in amount (perpatic). The phenocrysts are microlites of soda-rich sanidine. The clear, colourless, and birefringent constituents of the base likewise consist of felspar, whereas the yellowish isotropic portion consists of a mixture of crystallites, globulites and glass. A few minute tetragonal prisms and bipyramids with very high refractive index and birefringence are present. They probably consist of zircon.

Name: though rhyolitic in general appearance, no quartz is visible, so that we cannot say whether the rock is acid or intermediate. It is best called "hypohyaline zircon-bearing felsite" allied to pantellarite.

Fl. 2. Loc.: Stafford's Rock.

Handspecimen: whitish aphanitic rock with banded structure. A few megascopic felspar crystals occur in it.

Texture—Crystallinity: hypocrystalline. Grain-size very fine and even-grained base in each band. Fabric: trachytic; and porphyritic in microcrystalline phenocrysts immersed in a cryptocrystalline base.

Composition: the phenocrysts are corroded prisms of sanidine. The felspar of the base exists as microlites and crystallites. Skeleton-crystals are common. The rest of the base consists chiefly of isotropic material. The refractive index of the globulitic and glassy substance indicates the presence of much quartz. A few red specks of limonite, black grains of magnetite and zircon prisms occur. Some bands in this rock are coarser in grain-size than others.

Name: Trachytic Zircon-felsite, allied to Pantellarite.

Fl. 4. Handspecimen: a dark greenish-black rock looking like bottle-glass, which occurs as a flow underlying trachyte-felsite in Kelly's paddock, near Ivory Knob. Much of this rock is beautifully spherulitic.

Microscopically this rock consists of an isotropic glass, which shows beautiful perlitic structure. A few phenocrysts of orthoclase occur in it. These often include albite lamellæ in parallel intergrowth, and sometimes zircon.

Name: Perlitic Vitrophyric Trachyte, or Perlitic Trachyte-obsidian.

The SiO_2 percentage was determined, and found to be 69·74, so that this glass probably has the pantellarite composition.

Fl. 11. Handspecimen: a reddish, aphanitic, banded rock showing flow-structure; very like Fl.1, and Fl.2.

Microscopic texture: hiatal-porphyritic phenocrysts are seen in a microcrystalline to microspherulitic base. The phenocrysts consist of anorthoclase; felspar also forms stellate groups of crystallites in the spherulitic base. Most of the base appears to have the composition of felspar. Yellowish globulites, a few minute green ægirite fragments, some magnetite grains, and ilmenite plates, and a few xenogenic biotite- and quartz-fragments constitute the accessories, which all together form less than 2 % of the rock.

The silica percentage was found to be 72 %, hence the base must contain quartz.

Name: Microspherulitic Quartz-bearing Soda-Rhyolite, allied to Pantellarite.

Fl.9. Loc.: Summit of Mt. Blaine.

Handspecimen: white, megascopically porphyritic trachyte.

Texture—Crystallinity: holocrystalline. Grain-size: uneven, with serial porphyritic phenocrysts in a microcrystalline base; dopatic. Fabric: trachytic to orthophyric.

Composition: the main constituent is felspar. The phenocrysts vary in size from mediophyric to mediiphyric. Their refractive index is always less than that of canada balsam. Carlsbad twinning is common, but, in addition, we have a shadowy extinction due to the interlamellation of two different felspars, and to ultramicroscopic twinning, chiefly the latter. The phenocrysts frequently show an orthopinacoidal parting, and a corrosion-rim of heterogeneous composition. Two cleavages occur, and are, in some crystals or in parts of certain crystals, quite rectangular, in others not rectangular, The latter portions frequently exhibit distinct albite twinning, and have a higher refractive index than the others. They consist of albite or a variety of anorthoclase near albite. This kind of felspar frequently forms a rim round the sanidine-like variety. The extinction of the sanidine-like felspar is 11°. We have, therefore, three closely related felspars, often mutually intergrown: (1) soda-orthoclase, (2) microcline-microperthite (anorthoclase), and (3) albite. These three felspars commenced to form at the same time, but the excess of soda in the magma probably led the albite to continue to form after the others finished. The felspar of the base has the refractive index of albite. Generally speaking, the microlites of nephilinitoid habit have the properties of anorthoclase, and those of prismatic habit the characters of albite. Some of the phenocrysts show incipient decomposition to kaolin and a clear isotropic material like analcite. The other minerals observed in the slide are: (a) magnetite in idiomorphic grains, forming about 2 % to 3 %, (b) zircon in idiomorphic prisms (acicular), forming less than 1 %, and (c) minute grains of a greenish pyroxene and of a yellowish mineral which is probably wöhlerite or eucolite, and also a few specks of deep blue pleochroic riebeckite.

Name: Soda-Trachyte, near Orthophyre.

Fl.14. Handspecimen: porphyritic white trachyte occurring near Fl.13, and forming an older flow.

Texture: porphyritic-hiatal with cryptocrystalline base, partly pseudospherulitic (strahlenkörnig), in part pilotaxitic.

Composition: the most abundant components are felspar and isotropic or nearly isotropic base. In addition a little magnetite, acmite and rutile are present. The felspar is of two generations. The first generation, that of the phenocrysts, consists of a soda-rich variety of orthoclase which sometimes includes lamellæ of albite. The phenocrysts may be idiomorphic, or corroded, or allotriomorphic. Several bundles of phenocrysts occur which are inclusions of a medium-grained bostonitic rock consisting wholly of felspar. There is no proper corrosion-rim round any of them, yet some have been rounded, and strands of base have filled hollows formed by corrosion. The extinction angle varies from 4° to 8°, and the cleavage is rectangular. Twinning is wholly on the Carlsbad plan, and only the faintest traces of shadowy extinction are seen in some. The form of the felspars is orthorhombic. Evidently the phenocrysts and groupings of phenocrysts are derived from some previously consolidated bostonite or lestiwarite. The fabric of the groupings approaches that of lestiwarite, but the crystals are not wholly allotriomorphic as in many lestiwarites. The felspar crystals of the base are minute needle-shaped microlites which are doubly refracting, and still finer crystallites which are practically isotropic. These minute needles can be seen with the high power in non-polarised light. The whole mass exhibits a faint shadowy, pseudospherulitic extinction when the nicols are crossed. A cloudy grey, practically isotropic, base exists interstitially between the fine needles; this may consist of still finer crystallites and globulites of felspar, with or without either cryptocrystalline quartz or some felspathoid. As the rock is slightly decomposed, staining tests are not of much use, and, the SiO_2 percentage not having been determined, the exact composition of this groundmass must remain unknown for the present. The acmite is greenish-yellow and feebly pleochroic as in the trachyte from the summit of Mt. Flinders. It is very sparingly represented. Magnetite occurs in idiomorphic corroded grains, also in minute amount. Minute violet grains of a highly refracting and doubly refracting mineral also occur very sparingly. These are probably a titanium mineral allied to rutile.

Name: Pseudospherulitic Trachyte-Porphyry.

Fl.16. Loc.: Mount Flinders, east side, forming the main mass of the mountain.

Handspecimen: porphyritic light-coloured whitish trachyte.

Texture holocrystalline, hiatal-porphyritic, with phaneric phenocrysts in an aphanitic cryptocrystalline base. The rock is perpatic, the phenocrysts forming less than 10 per cent. With the high power, the base is resolved into microlites and crystallites having a trachytic fabric.

Component minerals: the chief constituent is felspar. The phenocrysts consist of felspar, with glassy inclusions. The extinction angle makes 9° to 10° with the composition-plane of the Carlsbad twins, and the extinction is somewhat shadowy. Small lamellæ of albite occur in some. Cross-cracking, as in sanidine, is universal. These characters point to the felspar being soda-sanidine or anorthoclase. The crystals are irregular in outline, some or other of the faces being always mutilated. Sometimes they occur in a group, and often they are corroded. These features suggest that they are torn out of a previously consolidated rock, as in Fl.14. Orthoclase and anorthoclase form the bulk of the base. They occur in the form of stunted laths and squares (sections of square prisms); they show shadowy and almost straight extinction and Carlsbad twinning. Other minerals occur only in minute amount, and consist of (1) minute needles of ægirine-augite; (2) irregular grains of magnetite; (3) granules of hæmatite and reddish iron-ores. There is also a little interstitial isotropic material, and some interstitial birefringent colourless matter is also present. This may be chalcedonic silica.

Analysis: the chemical composition of the rock was determined.

	Per cent.		Mol.
SiO_2	69·32	...	1·155
Al_2O_3	16·06	...	0·158
Fe_2O_3	1·42	..	0·009
FeO	0·88	...	0·013
MgO	0·06	...	0·001
CaO	0·31	..	0·005
Na_2O	6·01*	...	0·097
K_2O	4·23	...	0·045
H_2O	1·09	...	—
TiO_2	0·62	...	0·008
	100·00		

* Some impurity accidentally got into the alkali, hence the Na_2O was estimated by difference.

The analysis computed in accordance with the American system gives the following norm—

	Per cent.		Per cent.
Quartz	17·58	Magnetite............	1·16
Orthoclase...........	25·02	Ilmenite.........	1·22
Albite............... ..	50·83	Hæmatite	0·64
Anorthite............	1·35	Water..........	1·09
Corundum...........	1·12		

The rock therefore falls in Class i., Subclass i., Order 4, Rang 1, Subrang 4.

Magmatic name: Kallerudose.

Name: Porphyritic Soda-Trachyte.

Fl.12. A dark grey rock containing white fragments of trachyte-porphyry. The dark portion is a microcryptocrystalline to glassy lava which, under the high power, is seen to consist partly of crystallites, globulites, margarites and spherulitic tufts of crystallites.

The phenocrysts are idiomorphic and somewhat corroded. They are interesting as exhibiting in an excellent way the cause of the shadowy extinction of anorthoclase. Some crystals are composed of orthoclase and albite in parallel growth, each felspar being quite distinct. Others, in which the intergrowth is finer, must be classed as microperthite. In others again the extinction of the felspars is shadowy, but there is no evidence of intergrowth until the crystal is turned almost to the position of extinction, when it becomes faintly cross-hatched. Doubtlessly the shadowy extinction of anorthoclase, whether primary or induced by strain, is due to the interlamellation of two felspars and ultramicroscopic twinning in the plagioclase component.

All the rocks hitherto discussed are decidedly acid. They yield poor sandy grey soils.

2. *Trachytes*—(*b*) The True Trachytes.

Fl.A. Lava from the summit of Mt. Flinders.

Handspecimen: greenish-grey rock, mottled like "mackerel sky," and consisting of dark greenish areas intergrown with light greenish areas. Macroscopically very fine-grained.

Microscopic structure.—Texture. *a*.Crystallinity: holocrystalline. *b*.Grain-size: rather even-grained, microcrystalline, with a few small phenocrysts. *c*.Fabric: trachytic, with well-marked flow-arrangement.

Mineral Composition.—The rock is composed essentially of felspar and ægirine-augite, with magnetite, apatite, and a little fluorite present as accessories, and some reddish iron-ore and brownish serpentine as decomposition-products. The felspar consists entirely of lath-shaped microlites (of tabular and prismatic habits), some of which show Carlsbad twinning. The composition-plane is in the direction of the length of the laths. The extinction is almost straight in sections parallel to *a*(100), and in sections parallel to *b*(010) the extinction angle varies from nearly straight in the direction of the *c*' axis to about 12° on the edge bc. Extinction is, however, usually shadowy, a feature due either to strain induced by close packing of the microlites, or more probably to ultramicroscopic twinning. The glassy clearness of sanidine, and the cross-cracking parallel to *a*(100) are characteristic properties. The cleavage parallel to *c*(001) is good. With some difficulty the following optical properties were determined by the aid of the selenite plate; $\mathfrak{a}$ and $\mathfrak{c}$ are closely approximated so that the felspar is nearly uniaxial. It is optically negative ($Bx_a = \mathfrak{a}$). The birefringence-colours of the felspar and the selenite plate add when the $\mathfrak{a}$ of the plate is inserted in the long direction of the laths, and subtract when inserted transversely. The prisms and tables are elongated on the face *c* along the *a*' axis, and the tables are tabular on *b*. These properties fix the felspar as being a soda-orthoclase or anorthoclase.

The ferromagnesian mineral is in the form of minute greenish rods and grains, abundantly distributed in the dark patches of the rock, there forming ophitic or pœcilitic aggregates; and it also occurs as the nucleus of small phenocrysts, whose outer zone is a yellowish, feebly pleochroic acmite. The greenish pyroxene has the pleochroism: $\mathfrak{a}$ dark sea-green, $\mathfrak{b}$ light leek-green, $\mathfrak{c}$ yellowish-green, and absorption-scheme $\mathfrak{a} > \mathfrak{b} > \mathfrak{c}$. When a selenite plate is introduced in the direction of the length of the crystals, the polarisation-colour is raised; hence $\mathfrak{a} = c$; this was also found to be the acute bisectrix, hence the mineral is optically negative. The green pyroxene is undoubtedly *ægirine.* In the phenocrysts it is surrounded by a rim of yellowish or brownish nonpleochroic acmite with rather similar optical properties. The double refraction of the ægirine is about 0·050. Incipient decomposition to a brownish serpentine and to ferrite, with the occasional appearance of hornblendic cleavage, was noticed in the acmite.

Colourless, isotropic areas were noticed. Their refractive index was very low, and they probably consist of nosean decomposing to analcite and zeolites. Some nosean aggregates have been completely replaced by zeolites (natrolite and thomsonite).

Magnetite occurs in idiomorphic grains. Apatite occurs in stout acicular prisms interpenetrating both the pyroxene and felspar. Fluorite occurs in irregular grains, or aggregates of grains, known by their low refractive index, faint yellow or violet colour, and their isotropism. There are also a few grains of a bright yellow allotriomorphic mineral with high refractive index and low double refraction, probably *eucolite.*

Leaving out of consideration minor constituents, felspar forms practically two-thirds, and pyroxene one-third, of the total bulk of the rock.

Name: originally this was a nosean-bearing ægirine-anorthoclase-trachyte.

Chemical Composition :

	Per cent.	Mol.
SiO_2	60·58	1·010
Al_2O_3	18·06	0·177
Fe_2O_3	3·05	0·019
FeO	1·38	0·019
MnO	0·04	0·002
NiO. CoO	0·07	
MgO	0·23	0·006
CaO	1·74	0·030
K_2O	6·87	0·073
Na_2O	5·01	0·081
H_2O (at 100°C)	0·99	0·106
H_2O (above 100°C)	0·90	
TiO_2	0·83	0·010
Sum		99·75

Norm:

Quartz	1·50
Orthoclase	40·59
Albite	42·44
Anorthite	6·39
Diopside	1·68
Magnetite	2·09
Ilmenite	1·52
Hæmatite	1·60
Water	1·89
Sum	99·70

Chemical classification : Class i., Order 5, Rang 2, Subrang 3. Magmatic name : Pulaskose.

Fl. 13. Loc.: one of the northern foothills of Mt. Flinders. It overlies the light-coloured trachytes, and is probably the last flow.

Handspecimen : dark aphanitic rock with the characteristic fracture and aspect of the andesitic and phonolitic trachytes(even fracture).

Texture : holocrystalline, microcrystalline, even-grained; fabric intermediate between typical trachytic and typical pilotaxitic.

Composition : felspar forms about 75 %, ægirine 20 %, and magnetite 5 %. The felspar consists chiefly of acicular microlites, but partly also of allotriomorphic grains. Carlsbad twinning is frequent; albite twinning occurs occasionally, and shadowy extinction from crowding or ultramicroscopic twinning is very frequent. The refractive index is almost that of canada balsam. These properties indicate that the felspar is chiefly anorthoclase (soda-microcline ?), but true soda-orthoc ase and true albite are present in smaller amount. The ægirine is not quite fresh, being sometimes in an incipient stage of decomposition to chlorite, and shows a tendency to develop uralitic cleavage. The pleochroism is not very strong, being $\mathfrak{a}$ (near c′) bluish-green, $\mathfrak{b}$ brownish-green, and $\mathfrak{c}$ yellowish-green; and absorption $\mathfrak{a} > \mathfrak{b} > \mathfrak{c}$. The extinction angle is about 3° behind. The double refraction is 0·050. It is, therefore, an ægirine-augite. Magnetite is abundant in rounded grains. A colourless, dull grey mineral, with low double refraction and a refractive index slightly above canada balsam, occurs interstitially between the felspar, and is probably nepheline.

Order of consolidation : the felspar is studded with minute included rods of ægirine The magnetite is corroded; felspar frequently penetrates ægirite in an ophitic manner. The order therefore appears to be—

Magnetite ————
Ægirine ————————
Felspar (idiomorphic variety) ————————
Felspar (allotriomorphic) ————————
Nepheline ————————

Name: Phonolitic Ægirine-Trachyte.

Chemical composition:

	Per cent.	Mol.
SiO_2	56·78	0·946
Al_2O_3	14·47	0·142
Fe_2O_3	2·80	0·018
FeO	6·05	0·084
MgO	0·34	0·008
CaO	2·47	0·045
Na_2O	8·67	0·140
K_2O	4·51	0·048
H_2O(at 100°)	0·56	
H_2O(above 100°)	1·70	
TiO_2	2·00	0·025
NiO	0·05	0·001
MnO	tr.	
Sum	100·40	

Norm:

Orthoclase	26·69
Albite	35·11
Nepheline	7·67
Acmite	8·32
Sodium Metasilicate	3·42
Diopside	11·00
Olivine	2·74
Ilmenite	3·80
Water	2·26

Chemical classification: Class ii., Order 5, Rang 1, Subrang 4.
Magmatic name: Umptekose.

Fl.22. Loc.: Little Liverpool Range.

Handspecimen: a dark greenish-black, utterly aphanitic rock, very abundant on the eastern fall of the Little Liverpool Range. This rock passes into a microcrystalline rock similar to the trachy-andesites of the Warrumbungle Mountains, and Fl.13, Mt. Flinders. Only the aphanitic variety was collected.

Texture: microcryptocrystalline, perpatic; the base being barely resolved with the high power. There seems to be little or no glass.

Composition: a few microscopic phenocrysts, visible with the low power, consist of sanidine-like felspar. The base consists of an even-grained mixture of sanidine or anorthoclase in lath-shaped microlites; idiomorphic grains of greenish-brown, strongly pleochroic ægirine augite; minute idiomorphic magnetite grains, and cryptocrystalline interstitial matter. The fabric is trachytic.

Name: Ægirine-Trachyte, dark variety allied to Trachy-andesite.

Soil: this rock yields a good soil, rich in magnetite which collects as black sand in the streamlets after rain.

Fl.24. Loc.: Governor's Rock, top of Little Liverpool Range.

Handspecimen: somewhat decomposed, reddish, trachytic rock.

Texture: even-grained; micro- to cryptocrystalline with pilotaxitic fabric.

Composition: the felspars are anorthoclase and oligoclase in equant and acicular microlites. The base is decomposed and kaolinised. The original soda-amphibole is decomposed to red iron-ore, which is left in ophitic (mossy) aggregates.

Name: Oligoclase-Trachyte.

Soil: sandy and poor. This formation covers a considerable area on the range.

Fl.19. Loc.: various places south of Engelsburg.

Porous (miarolitic) coarse-grained grey rock in handspecimen, not unlike some specimens of Gib syenite-pegmatite (bowralite). The rock, on account of its porous nature, is very difficult to section. The slice examined was greatly broken up, yet sufficient portions retained cohesion so as to show structure and composition.

Texture—Crystallinity: holocrystalline. Granularity: medium, uneven, serial-porphyritic, persemic. Fabric: hypidiomorphic-granular.

It appears like a coarse-grained rock, but in the interstices, between the idiomorphic large crystals, are smaller crystals of hypidiomorphic or allotriomorphic outlines.

Composition: the large crystals forming the main bulk of the rock are idiomorphic, and belong to two felspar-species, (1) *oligoclase* known by its refractive index slightly above that of canada balsam, and double refraction slightly higher than orthoclase; and (2) anorthoclase.

The oligoclase exhibits carlsbad, albite and baveno twinning; and also beautiful mechanical and optical zoning, the former due to bands of dusty material and minute sagenitic rutile needles, arranged parallel to the outlines of the crystals; the latter kind of zoning is less universal, and not of such constant character. It is due to the interlamellation of two or more kinds of felspar in the same crystal, the more acid zone being usually exterior, extinguishing practically straight, and the more basic zone interior, extinguishing at 5°. Occasionally the core and the outermost zone are identical in composition, and more acid than an intermediate zone. The more acid zones consist of orthoclase or anorthoclase, and in rare cases of albite. The second type of phenocryst behaves like orthoclase, but exhibits shadowy extinction and sometimes very feeble polysynthetic twinning. It, too, possesses mechanical zoning. It is evidently anorthoclase.

All the phenocrysts are crowded with inclusions of sagenitic, greenish to colourless, rutile needles. Some of the smaller interstitial needles behave like orthoclase but are probably a soda-rich variety. Others consist of light green or greenish-yellow, faintly pleochroic augite-acmite which is also full of rutile inclusions, and is decomposing to chlorite. The augite-acmite is almost idiomorphic; its extinction angle is fairly high, approaching that of diopside; and it frequently has developed a hornblendic cleavage (uralitic decomposition). A development of secondary arfvedsonite round the augite-acmite is frequently distinct, and is another point of affinity with bowralite (Mawson). The arfvedsonite is much more sparing. It occurs in allotriomorphic patches enveloping augite, and is also seen in irregular cavities associated with quartz, when it is probably formed in the pneumatolytic period of consolidation. Allotriomorphic ilmenite also occurs interstitially; it is largely decomposed to leucoxene. Strands and grains of chlorite and kaolin-like decomposition-products are in evidence between the crystals of ferromagnesian mineral. A little iron-ore is also present.

Name: Arfvedsonite-bearing Syenite-Pegmatite allied to Bowralite.

Note: this rock occurs in large bodies, not small veins. The exact field-relations have not been worked out. It decomposes, producing red or brown rich soil which supports luxuriant scrub.

Chemical Composition :

	Per cent.	Mol.	Norm:	
SiO_2	62·25	1·036	Quartz	2·34
Al_2O_3	15·49	0·152	Orthoclase	15·57
Fe_2O_3	5·44	0·034	Albite	64·98
FeO	0·15	0·002	Acmite	3·70
MgO	0·84	0·021	Diopside	2·16
CaO	1·82	0·032	Hæmatite	4·16
Na_2O	8·18	0·132	Hypersthene	1·10
K_2O	2·57	0·028	Ilmenite	0·46
H_2O	1·26		Sphene	4·31
TiO_2	1·85	0·024	Water	1·26
	99·85			100·04

Chemical classification : Class ii., Order 5, Rang 1, Subrang 4.
Magmatic name : Umptekose.

Fl.20. Loc.: The Elbow, Old Warwick Road, Little Liverpool Range.

Handspecimen : dark greenish-black, vitreous rock.

Texture : hemicrystalline, with microlitic phenocrysts in a glassy base. The fabric is hyalopilitic.

Composition : the microlites consist chiefly of sanidine (perhaps anorthoclase). Sparingly represented we have minute idiomorphic grains of greenish, faintly pleochroic ægirine-augite; black idiomorphic grains of magnetite, and a little ilmenite; also a few rods of zircon. The rest of the rock consists of a cloudy yellowish glass, which, from its frequent display of feeble polarisation, is probably undergoing perlitic devitrification.

Name : Vitrophyric Trachyte.

Note.—This rock was obtained beneath a sheet of basalt, overlying which there is a trachyte capping. The basalt is probably a sill, for it seems to diminish in grain-size towards the borders.

Fl.27. Loc.: Little Liverpool Range, eastern slope, on Old Warwick Road, at an elevation of 2,000 feet.

Handspecimen : a brownish-grey rock, with subconchoidal fracture, and consisting of white felspar masses in star-like groupings, embraced in a brownish matrix.

Texture: almost holocrystalline, uneven-grained, consisting of crystals of various sizes (all microscopic) ranging down to interstitial isotropic matter. The fabric is a variety of pilotaxitic, very close to panidiomorphic-granular.

Composition: the main constituent is felspar, the crystals of which exhibit shadowy extinction, and Carlsbad twinning. The refractive index is very slightly below that of canada balsam. The felspars are mostly tabular in habit, and almost idiomorphic, fitting beautifully into one another as in a mosaic. They consist chiefly of anorthoclase, but a little albite and oligoclase appear to be present also. Baveno and Manebach twinnings are present in some crystals.

Pyroxene is wholly absent, but a yellow mineral takes its place. This mineral is pleochroic from greenish-yellow to honey-yellow; it has a high refractive index, and a medium double refraction (about 0·018). It appears to be optically positive. Complex twinning is occasionally seen in it, and extinction is straight with the cleavage. It is sometimes stained with yellowish or brownish decomposition-products. Some of the small grains are square, and exhibit rectangular cleavage; others seem to have pyramidal terminations. It is probably a tetragonal mineral, isotropic sections being met with. One of its most remarkable properties is, that numerous individual grains of it lying within certain areas are optically continuous so that the felspar is ophitically embraced in it. In optical properties this mineral is nearest to meliphanite. Mr. Wright, Assistant Demonstrator in Chemistry at the University, has found beryllium in the rock; but in other respects, as, for example, the high TiO_2, the rock-composition would indicate that this mineral must belong to the lävenite group. There is no other mineral present which is rich in titanium; hence in this unknown mineral we must include the following molecules as determined from the norm: acmite 5·08, hypersthene 0·20, titanite 4·12, ilmenite 0·15.

Another yellowish-brown mineral present in the rock exhibits no pleochroism, and shows sometimes a fibrous radial structure. It is almost isotropic and appears to be chalcedony. Hæmatite is fairly plentiful, and appears to be secondary after cubes of magnetite. Chloritic and serpentinous decomposition-products occur more sparingly, and a little interstitial fluorite seems present.

The peculiar texture and composition of this rock indicate that it consolidated under the influence of pneumatolytic action. It forms a dyke in trachyte-tuffs.

Name: Panidiomorphic Soda-Trachyte.

Chemical Composition:

	Per cent.	Mol.	Norm:	
SiO_2	65·09	1·085		
Al_2O_3	14·43	0·141	Quartz	10·32
Fe_2O_3	3·21	0·020	Orthoclase	18·90
FeO	0·13	0·001	Albite	56·07
MgO	0·10	0·002	Acmite	5·08
CaO	1·18	0·021	Hypersthene	0·20
Na_2O	7·26	0·118	Hæmatite	1·44
K_2O	3·24	0·034	Titanite	4·12
H_2O	2·42		Ilmenite	0·15
TiO_2	2·50	0·031	Water	2·42
	99 56			

Chemical classification: Class i., Order 5, Rang 1, Subrang 4.

Magmatic name: Umptekose.

Note.—This rock will be further investigated when more and better material are obtained. The unknown mineral appears to be quite a new one.

3. *The Andesites.*

Fl.23. Loc.: near Hotel Reserve, Little Liverpool Range.

Dark vesicular andesite containing white, decomposing plagioclase phenocrysts which fall out in grinding the section.

Texture: holocrystalline, perhaps hypocrystalline. Fine-grained, with medium to coarse phenocrysts. Serial porphyritic, dopatic. Fabric, pilotaxitic intersertal.

Composition: the felspar phenocrysts consist of andesine; felspar forms the main constituent of the rock. The smaller crystals are mostly andesine, but some are distinctly oligoclase and albite. The andesine and oligoclase exhibit Carlsbad and albite twinning. Habit, tabular and prismatic, lath-shaped sections abundant. Some oligoclase crystals are nicely zoned. Optical zoning is most prevalent. Some are mechanically zoned, and outside the dusty zone of inclusions there is a border of anorthoclase. In one corner of the slide is seen an aggregate of large oligoclase phenocrysts which, in unpolarised light, appear a homogeneous mass of felspar studded with inclusions of iron-ore and decomposition-products, but which, between crossed nicols, is resolved into a cluster (xenolith of the same magma). Its appearance is very like that described by me in these Proceedings for 1907 (pp.611, 612, and Plate xxxii., fig.3).

Acicular crystals of a variety of hornblende have been present, but have only left their traces in masses of secondary magnetite. A little ilmenite and primary magnetite are present. Apatite is sparingly represented in minute needles. Kaolin and other dusty decomposition-products are abundant, and secondary analcite appears also to occur in the base.

If the yellowish isotropic material be not all the result of decomposition, a yellowish glassy base is present.

Name : Andesite.

Other specimens from the same spot are rich in specks of chloritoids, allophane, and delessite of beautiful blue and green colours.

Soil : black and fertile.

Fl.25. Loc.: dyke in trachyte-tuff near Anderson's, Little Liverpool Range.

Fine-grained, greenish, aphanitic rock which has a greasy lustre, and metallic ring like phonolite.

Texture: holomicrocrystalline, porphyritic in a few microscopic, rarely phaneric, phenocrysts; perpatic, with even-grained trachytic base.

Composition : the main constituent is felspar. The felspar phenocrysts consist of an acid andesine in idiomorphic, sometimes corroded phenocrysts. Carlsbad, albite, and pericline twinning are shown. The habit of the phenocrysts is tabular. The smaller felspar laths of the base consist of andesine, oligoclase, and perhaps anorthoclase, showing Carlsbad or albite twinning. Manebach twinning has been noted in some cases.

Augite is next in importance, constituting perhaps 10 % of the rock. It is of a light greenish, almost non-pleochroic variety, and occurs in idiomorphic, but slightly corroded, square prisms. The faces *a* (100), *m* (110), and *c* (001) appear to be well developed, and *b* (010) not so well developed. The prismatic cleavage is poor, but a marked cleavage parallel to *a* (100) exists in many crystals, and a parting parallel to c occurs also. Extinction angle $\mathfrak{c}$: c about 45°. Optically +^{ve}. A twinning parallel to a dome, probably (101), is well marked; contact twins, tw. pl. *a* sometimes occur, and a polysynthetic twinning parallel to *a* occurs in other crystals. This kind of twinning may be due to decomposition, for most of the augite is developing a hornblendic cleavage. Zonal banding occurs. The properties determined point to an augite lying between true augite and ægirine-augite. The double refraction is only 0·024, near that of diopside. Inclusions of a yellow, feebly birefringent mineral occur as rounded masses in the core of some augite crystals. The refractive index of these inclusions is high. They may consist of a variety of allanite. Magnetite occurs in fair amount (up to 5 %) as idiomorphic grains. Apatite occurs as stunted rods and long needles penetrating both felspar and augite. Decomposition-products, such as red-iron ores, chloritic staining, kaolin, etc., from alteration of augite and felspar, occur in large amount. No nepheline seems to be present.

Name : Alkaline Augite-Andesite.

Order of consolidation :

1. Magnetite ———
2. Apatite ————————
2. Augite (1st gen.) ————
4. Felspar (1st gen.) ————
5. Augite (2nd gen.) ————
6. Felspar (2nd gen.) ————

4. *The Basalts.*

Basalts abound on the Darling Downs tableland, to the west of the Little Liverpool Range. Basaltic eminences also occur east of the Range, and on top of it. The basalts are typical, normal olivine basalts. In addition, great areas of country between the Fassifern district and the Birnam Range, near Beaudesert, are covered with coarse-grained dolerites which closely resemble the gabbros of the D'Aguilar Range, north of Ipswich. These dolerites represent sills intruded into tuffy sandstones of Trias-Jura age. One of them (Fl.21) is selected for description.

Fl.21. Dark, coarse-grained gabbroic rock occurring as xenoliths in a decomposed dolerite-laccolite near Milora State School. The xenoliths are of the same magma as the main rock. These rocks are probably older than the trachyte-series.

Texture: holocrystalline, coarse and uneven-grained, magnophyric. Hypidiomorphic granular fabric. The rock looks fresh in handspecimen, and is very hard to break; but the abundance of zeolites in the section shows that it is somewhat decomposed.

Composition—Felspar: some of the more decomposed crystals have the composition of anorthite (extinction angle 45°), but other fresher crystals (one of which showed symmetrical Carlsbad and albite twinning) have an extinction angle of about 24° in symmetrical sections, indicating labradorite. The decomposing anorthite crystals contain strands and irregular masses of analcite; they are probably only altered labradorite. Analcite is abundant, amounting to probably 10% of the rock in area. Some of it appears primary, just as in the Prospect dolerite, and shows crystalline outlines. Anomalous double refraction sometimes occurs in it. The felspars possess Carlsbad, albite, and sometimes pericline twinning. The zeolites, thomsonite, mesolite, and natrolite, all occur in fibrous radial aggregates associated with analcite. Sericite also occurs. These are all decomposition-products of the felspar.

Augite occurs in hypidiomorphic crystals of a light brownish colour inclining to salmon-pink. The extinction angle is about 45°, but in some crystals undergoing uralitic decomposition and developing hornblendic cleavage it is only about 20°. The augite is studded with idiomorphic magnetite inclusions. It appears somewhat titaniferous.

Minor constituents: ilmenite and titaniferous magnetite occur in about equal proportions. Red iron-ores secondary after augite, magnetite, and ilmenite also occur. A little serpentine and leucoxene have also been noticed. Olivine has not been present in the rock at all.

Name: it is clearly an altered soda- and titanium-rich augite analcite gabbro, and the weathered doleritic matrix must be looked upon as a hypabyssal analcite-dolerite without olivine. Near Teschenite.

Soil: rich brown and black soils.

Note: by the inclusions of one mineral in another, the order of consolidation is found to be—

1. Magnetite and ilmenite ————
2. Augite ————
3. Felspar ————
4. Analcite ————

Apatite is wholly absent, a rare thing in this rock-type.

Summary.

The Flinders volcanic rocks present the following peculiarities:

1. They are nearly all intermediate, approaching phonolitic rocks in chemical and mineralogical composition.

2. They have partially crystallised at a depth before further earth-movements caused their refusion and expulsion; hence the coarsely crystalline xenoliths occurring in them.

3. They invariably contain pneumatolytic minerals, *e.g.*, arfvedsonite, zircon, rutile, etc.

The Fassifern alkaline volcanic rocks have the following features:—

1. They vary in basicity, from the most acid to the most basic, ranging from comendites to what are practically ali-basalts (alkaline basalts).

2. Xenoliths due to inclusion of partially consolidated portions of the same magma occur in both acid and basic rock-species.

3. Evidences of pneumatolysis are abundant; in the commoner rocks they are met with in the minerals zircon, rutile, arfved-

sonite and fluorite; and amongst the rarer rocks we get pegmatites carrying arfvedsonite, rutile, zircon, and fluor, panidiomorphic trachyte with meliphanite(?), fluor, zircon, chalcedony, etc.

4. Abundant tuffs, breccias and highly vescicular lavas are represented (also at Mt. Flinders).

5. Oligoclase is a commoner ingredient in the Fassifern trachytes.

The points specified show that the magma was rich in water, fluorine, etc.

The greater richness of the soil in the Fassifern district than in other trachyte areas is readily seen to be due, in part at least, to the presence of oligoclase (carrying lime) in the trachytes, and to the fact that ægirine-augite (carrying MgO and CaO) largely replaces true ægirine.

The occurrence of alum in the Mt. Flinders breccia proves the presence in it of sulphur-rich minerals such as nosean. Further, the cobalt stains in the breccia and the amount of combined nickel and cobalt oxides (0·07 %) in the lavas, show that here again, on approaching the D'Aguilar Range, we enter a nickeliferous province, as I have indicated in my paper on the "Geology of the East Moreton and Wide Bay." Such a high percentage of NiO.CoO is not met with in the New South Wales trachytes.

It might further be pointed out that in the Flinders-Fassifern alkaline province—

1. The same minerals are met with as in other Australian alkaline provinces, though the lime-percentage is slightly greater.

2. The same volcanic sequence occurs, and the same associated rocks as in other alkaline provinces. The monchiquites of the Nandewars and essexites of the Mittagong area are here represented by analcite-dolerite (teschenite), and this rock is older than the trachyte. After this the sequence is from the more acid to the more basic.

3. The craters of eruption are situated mainly along two great fissures which bound the senkungsfeld area of the Walloon Coal Measures, in the same way as I have hinted that the Warrumbungles may be a senkungsfeld area, and I have shown that a subsided area exists west of the Nandewars.

4. The Fassifern trachytes lie immediately to the east of the Darling Downs uplifts just as—

(a) The Glass Houses lie east of the Woodford raised peneplain.

(b) The Yandina trachytes east of the Blackall Range and Cooran uplift, and west and south of the Woondum horst.

(c) The Nandewars west of the New England uplift.

(d) The Clarence trachytes east of the New England uplift.

(e) The Warrumbungles some distance west of the New England uplift, just as Mt. Flinders lies some distance east of the Darling Downs uplift.

(f) The Gib and the Canoblas west of the Blue Mountains uplift.

Much work has to be done before the plains and peneplains mentioned can be properly correlated, but in this work the trachyte-lines will be a source of valuable information.

EXPLANATION OF PLATES I.-VI.

Plate i.

Map of the Mt. Flinders and Fassifern Alkaline Area.

Plate ii.

Map of Mt. Flinders.

Plate iii.

Fig. 1.—View of Mt. Flinders from slopes of Mt. Blaine, looking south.

Fig. 2.—The Alum Cave, Mt. Flinders.

Plate iv.

Mt. Blaine, looking north.

Plate v.

Fig. 1.—View of Mt. Goolman and Ivory's Rock from Kelly's house, looking east.

Fig. 2.—View of Mt. Blaine, looking east-south-east from Kelly's paddock.

Plate vi.

Fig. 1.—View of Stafford's Rock, looking south.

Fig. 2.—View of Mt. Flinders, looking south-east from Kelly's paddock.

CAN OPSONINS BE OBTAINED DIRECTLY FROM BACTERIA AND YEASTS?

By R. Greig-Smith, D.Sc., Macleay Bacteriologist to the Society.

The curve of the opsonic indices of an individual who has been treated with a bacterial vaccine, shows soon after inoculation a fall and a subsequent rise, after which the curve remains at a level higher than it had before the inoculation. The falling and rising have been called by Wright the negative and positive phases. It is reasonable to suppose that the injected microbe gives out a substance, either an anti-opsonin or an anti-phagin, which is responsible for the negative phase. We know that saline does extract such a substance from bacteria.* But it is not known if, subsequent to the liberation of all the anti-phagin, the bacteria give off the opsonin which produces the positive phase. From what we believe to be the mechanism of immunisation, it is probable that the opsonin is not derived directly from the bacteria but rather from the body-cells in response to the anti-phagin. On the other hand we know that the ingestion of yeast, from which I have not been able to obtain evidence of the secretion of an anti-opsonin, leads to the production of a certain amount of immunity against staphylococcus. The digestion of the yeast would therefore appear to give rise to opsonin, and such being the case, it is difficult to think otherwise than that the digestion of the bacteria would bring about the same result. We know that bacteria and yeast are comparatively rich in nucleoproteid, and we have it from Busse that nucleic acid protects the individual against the invasion of staphylococci and *B. coli*.

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*These Proceedings, 1908, p.669. As the anti-body is not destroyed at 70° it is not aggressin.

In an attempt to detect the liberation of opsonin from bacteria under the influence of pepsin-hydrochloric acid, ferric chloride was added to assist digestion. Experiments had shown that a greater loss of staining power as indicated by the Gram method of staining was obtained when to the pepsin-hydrochloric acid, salts of iron, calcium, barium, nickel or aluminium had been added, and of these salts ferric chloride appeared to be most active.

The results of a great number of experiments made with yeast and with *Staphylococcus aureus* which in some cases had been heated in saline at 60° for an hour, showed that no opsonin was liberated. The bacteria, either when heated or not, continued to give off anti-opsonic bodies for a considerable time.

In experiments such as these it is necessary to have the digested extracts absolutely free from bacterial cells. This condition was not always obtained upon neutralising the acid ferric chloride with sodium carbonate as the precipitate of ferric hydrate appeared to be too rapidly formed to entangle all the bacterial cells, and an apparently brilliant fluid contained enough cells to vitiate the results. A clear and trustworthy fluid was obtained by treating the first clear extract, freed from iron, with calcium chloride and phosphoric acid and neutralising with sodium carbonate. The precipitate of calcium phosphate is formed slowly and entangles all the partly digested bacteria.

Subsequent treatment of the bacteria with pancreatic extract (liquid pancreatin from Parke, Davis & Co.) in faintly alkaline solution or in 0·2% Na_2CO_3 also gave negative results.

Yeast-extract as obtained by grinding up yeast with sand and extracting the mass with a small quantity of saline also showed no trace of opsonin.

It is concluded from the research that opsonins are not directly obtainable from either bacteria or yeast.

THE COAGULATION OF CONDENSED MILK.

By R. Greig-Smith, D.Sc., Macleay Bacteriologist to the Society.

Much has been written about the sliminess of milk and of the bacteria which bring about the change. But the literature respecting a similar change in condensed milk is so scanty that I have not been able to find any publication dealing with the subject. It may be that the matter has never been treated, and yet for reasons that will be seen later, the trouble can hardly be unknown to the manufacturers of condensed milk.

The specimen of coagulated or "jellified" milk which I received had been made some six months previously, and when opened, the milk was seen as a stiff, rather dark-tinted jelly of the consistency of stiff starch-paste. Upon vigorously stirring the milk, it became thin but returned to its stiff consistency upon standing.

The microscopical examination of the jelly showed amongst the crystals of lactose, a number of clusters of needle-shaped crystals. These were also seen in normal condensed milk, but were not so numerous. The clusters were not affected by dilute alkali but dissolved in dilute acid, leaving a nucleus or residuum of microbic cells. A small quantity of these crystals was obtained by centrifugalising the diluted milk, and dissolved in nitric acid and tested for phosphoric acid, with negative results.

It was difficult to say whether the microbes were sarcinæ or staphylococci; they were large-sized and stained deeply, the stain being retained by the Gram method. They occurred in pairs and in groups, each individual measuring $1{\cdot}5\mu$. Upon cultivation they grew as small cocci, 1μ in diameter.

The formation of the jelly does not proceed uniformly throughout the milk, but begins at a number of points. These appear as small blobs of the size of millet seed. The thickening then proceeds radially, and finally the enlarged blobs or lumps fuse together into a solid jelly. This occurs when the milk is at rest. When agitated from day to day, as was done in the experimental work which will be mentioned later, the thickening begins at the surface-margin and proceeds inwards and downwards.

The manufacturer considered that the trouble was caused by a fault in the condensing plant, which, he considered, permitted the entry of water carrying salts of lime and magnesia in solution, and this appeared to be a feasible explanation in view of some experiments that were made by the Department of Agriculture of Victoria. Briefly, these experiments consisted in adding small quantities of lime salts ($=0{\cdot}02\%$ of $CaCO_3$) and of magnesia salts, and incubating the milk thus treated. It was concluded that small quantities of lime and magnesia salts bring about a thickening or coagulation of condensed milk, and in this connection it was noted that saccharated lime or viscogen is used commercially to thicken cream.

The action of the small quantities of calcium carbonate was so unexpected, that I repeated the experiment with specimens of condensed milk from the same firm. These specimens were described as showing no tendency to coagulate. A control test was made at the same time and treated in the same way with the exception that the calcium and magnesium salts were not added. Both tests were retained in the flasks in which the milks had been agitated for two hours at 54° previous to incubation at 37°. The contents of the flask with the salts showed signs of thickening on the fifth day, when a few nodules were visible at the surface margin, and it appeared as if the salts had induced the formation of the viscosity. Then the milk began to thicken from the margin of the surface inwards. At this time, however, it was noted that the check-test had also begun to thicken. The coagulation proceeded in both tests until in about a month the contents of each flask had become a jelly. The only differencc between the two was that the test with the salts had a start of two or three days over the control. Both of these milks contained the coccus which had been in the original condensed milk.

A tin of milk which had been made after the supposed fault in the condensing apparatus had been remedied and which was said to be capable of standing prolonged incubation without change, was placed in the incubator for ten days. Upon opening the tin and examining the milk, a considerable number of small blobs of jelly were found distributed throughout the milk. These blobs contained the micrococcus. It is therefore evident that the infection and subsequent alteration of the milk had little if anything to do with the entry of water containing calcium and magnesium salts in solution.

The micrococcus was obtained in pure culture by plate-cultivation and its bacterioscopic characters were noted. With the pure culture several experiments were made. In one of these, portions of approximately 25 c.c. of Nestlé's condensed milk, which keeps well in this climate, were transferred into a series of sterile flasks. Two of these had 0·0025 grm. of chalk added, and all were heated in a water-bath at 60° for an hour. The flasks were then infected, covered with rubber-caps, and placed in an incubator at 37°.

	11 days.	19 days at 37°.
milk (control)	no change	no change
,, + coccus	thickened	very much thickened
,, ,, + *B. acidi lactici*	,,	,, ,,
,, + chalk (control)	no change	no change
,, ,, + coccus	very much thickened	coagulated

The experiment clearly shows that the coagulation of the milk is brought about by the micrococcus and that the alteration can be assisted by small quantities of calcium carbonate.

A repetition of the experiment, using Nestlé's milk which had been heated for six hours in its tin at 60,° was made.

	14 days.	27 days at 37°.
milk (control)	no change	no change
,, + coccus	much thickened	very much thickened
,, ,, ...	,, ,,	,, ,,
,, + chalk (control)	no change	no change
,, ,, + coccus	much thickened	very much thickene

A tin of Nestlé's milk was heated at 60° for two hours, then the lid was punctured and the milk infected with a blob from a coagulating milk. The small orifice was sealed with paraffin and the tin was incubated for a month at 37°. Upon opening the tin it was found that the milk in the neighbourhood of the orifice had become coagulated. The infecting blob had remained at the point of infection and had not mixed with the bulk of the milk.

Another experiment was made with a tin of pasteurised Nestlé's milk, but in this case the milk was infected by means of small capillary tubes containing pure cultures of the micrococcus; the thin tubes were pushed right into the milk and were then broken off. The small hole in the tin was then sealed with paraffin as before. Upon opening the tin a month later, the contents were found to be very stiff and lumpy, a signal evidence of the action of the micrococcus. A control-tin of milk which had been opened and sealed at the same time was unaltered.

It is clear from these experiments that it is the micrococcus which is responsible for the coagulation of the condensed milk.

The causative micrococcus is probably by no means rare, and, as I have separated it from a sample of Nestlé's milk which is prepared in Switzerland or Norway, it would appear to be of universal occurrence. The Nestlé's coccus was identical morphologically and culturally, and it produced the same characteristic coagulation and lumpiness in test-flasks.

Since the coccus is found in milks which keep perfectly, there must be some condition which is necessary in order that the change may occur. The most feasible is the presence of a quantity of air in the tins. The coccus is aërobic, and in the experimental flasks the thickening begins where the film of milk is thinnest and most completely aërated, that is, at the margin of the surface. In the tins in which the affected milk was contained, there was a considerable space filled with air, while in the tins of Nestlé's milk the air-spaces were very small. In the latter case it is possible that the gas is inert, and, if so, the condition for the growth of the coccus would be so unfavourable that no alteration would occur.

On the other hand, air does not appear to be an absolute necessity. This was shown in an experiment in which the influence of air was tested. A series of portions of Nestlé's condensed milk was put into wide tubes, covered with vaseline, and heated for an hour at 60°. These were infected through the small central hole that formed on cooling the tubes. Then a thicker layer of melted vaseline was superposed. The tubes were incubated at 37° for two months. Upon removing the vaseline and examining the contents, it was found that the milks were thicker than when they were put into the tubes. Control tests with and without chalk were similar, while others sown with the coccus with and without chalk showed swollen masses near the vaseline where the milk had been infected. The coccus in the tube with the chalk produced the larger mass of coagulated milk. This experiment makes it appear that the presence of air is not a necessary condition for the coagulation of the milk, and that the addition of lime-salt, such as the carbonate, undoubtedly accelerates the thickening.

With regard to the nature of the substance that forms the jelly, it may be a slime or gum derived from the saccharose or lactose through the biochemical activity of the microbe. On the other hand it may be altered casein. To elucidate this question, many experiments were made in an endeavour to induce the coccus to form slime on artificial media, but all were fruitless, and I was driven to the alternative that the microbe simply alters the casein. There is some reason for the belief that the coagulation is an alteration of the casein. The microbe produces a considerable amount of acid in media containing lactose such as milk or lactose nutrient agar. Milk is coagulated and the acidity of the whey is so pronounced as to make it appear evident that the coagulation is brought about by the acid and not by a production of bacterial rennin-like bodies. Experimental plates of milk-agar and litmus-milk-agar, when seeded with a giant colony of the coccus, showed an amœboid growth upon the surface of the agar; but underneath and for some distance around the amœboid processes the milky medium was opaque while the other parts of the medium were translucent.

The supposition that the coagulation was entirely an acid coagulation was, however, shown to be wrong by the following experiment. Infected milk, with and without the addition of chalk, was poured into separate Petri dishes which were incubated at 22° for three days, when they were transferred to the incubator at 37°. Four hours later, the chalk-test had coagulated while the other had partly coagulated. The reaction of the coagulated milk with the chalk was neutral, while the partly coagulated milk was acid. The neutral reaction of the coagulated milk with chalk shows that the thickening was not caused by the formation of acid, but resulted from the action of an enzyme secreted by the micrococcus.

The coagulated milk is more acid than uncoagulated milk of the same maker; for example, a 20% solution upon being tested showed an acidity to phenolphthalein equal to 42 c.c. of $\frac{N}{10}$ per 100 grm., while an uncoagulated milk equalled 24 c.c. Much the same fact was shown in an experiment in which dilute acid was added to 50 c.c. of the 20% solution of the milk in a bottle. The volume of $\frac{N}{10}$ acid required to produce incipient coagulation, visible as minute specks upon the side of the bottle after shaking, was noted. The coagulated milk required 9·6 c.c., and the uncoagulated 11·1 c.c. These experiments should be considered in conjunction with the fact that the tins had been opened, and the milks exposed to the air for some time, the coagulated milk for 7 days, the uncoagulated for a month.

Experiments were made to determine the lethal temperature, but at the time this was done, the micrococcus had apparently deteriorated, as an exposure in milk at 63° for 10 minutes sufficed to kill it. A fortnight later the lethal temperature was found to be 61°. These temperatures cannot be taken as conclusive, and as the death-point was not increased by subsequent subculture, the lethal temperature remains unknown.

With regard to the cultural and other characters of the coccus, it measures 1μ, stains well and is Gram-positive. Upon agar, there forms a porcelain-white, raised and fat-glistening growth. Bouillon becomes turbid and a coherent sediment is produced;

indol is formed and nitrates are reduced to nitrites. On potato a moist transparent growth is slowly formed. Gelatine is slowly liquefied, and no gas is produced from glucose. In stab-culture, the gelatine is softened and the growth gravitates. It is not pathogenic to mice.

These characters show that it is only distinguishable from *Micrococcus pyogenes* γ *albus* (Rosenbach) by its being non-pathogenic to mice.

Postscript (*added 30th April, 1909*).—After this paper was read, a fresh specimen of coagulated milk was obtained. The micrococcus was isolated and its lethal temperature tested immediately after isolation. The infected milk exposed for 10 minutes at 62° was coagulated and at 63° was unaltered upon incubation.

NOTES AND EXHIBITS.

Mr. D. G. Stead exhibited a rough sketch of, and read a letter from a correspondent living on the Manning River, giving particulars of an unidentified marine animal, or portion of an animal, recently found on the sea-shore on the north side of Saltwater Creek, by the writer of the letter.

As showing how the English fox is spreading, Mr. H. J. Carter reported that he had in his possession the skin of one recently shot at Darling Point by his gardener, who had been put on the alert by depredations in the fowl-yard.

Dr. R. Greig-Smith exhibited a sample of "jellified" condensed milk in illustration of his paper.

On the motion of Mr. Stead, it was resolved: That the congratulations of this Society be forwarded by letter to Lieut. Shackleton upon the great results of his South Polar Expedition.

WEDNESDAY, APRIL 28TH, 1908.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, April 28th, 1909.

Mr. C. Hedley, F.L.S., President, in the Chair.

The President announced that, under the provisions of Rule xxv., the Council had elected Dr. T. Storie Dixson, Mr. T. Steel, F.L.S., F.C.S., Mr. A. H. Lucas, M.A., B.Sc., and Mr. J R. Garland, M.A., to be VICE-PRESIDENTS; and Mr. J. H. Campbell (Royal Mint, Macquarie Street) to be HON. TREASURER, for the ensuing Session.

A letter from Lieutenant Shackleton, Commander of the British Antarctic Expedition, 1907, thanking the Society for its congratulations, and for the expression of its appreciation of the scientific and other work of the Expedition, was read to the Meeting.

The President called attention to Circulars Nos. 3 and 4, issued by the Organising Committee of the Third International Botanical Congress, to be held at Brussels in 1910. The Circulars in question, copies of which were laid upon the table, relate to questions concerning the teaching of botany, and the indexing and collating of all literary and informative material that may be of service to the botanist. It is proposed to bring up these subjects for discussion at the Congress, and contributions thereto are invited.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 6 Vols, 49 Parts or Nos., 5 Bulletins, 2 Reports, 9 Pamphlets, and 2 Maps, received from 47 Societies and 3 Individuals, &c., were laid upon the table.

NOTES AND EXHIBITS.

By kind permission of Lieutenant H. E. Shackleton, the President exhibited a collection of mollusca dredged by the zoologists of the Antarctic Expedition, in 20-80 fathoms off Cape Royds.

Mr. David G. Stead exhibited some specimens of a small freshwater perch, *Therapon unicolor*, Günth., from an artesian well at Corella, in the north-west of New South Wales. The evidence forthcoming seemed to justify the belief that the fishes had come up the bore with the escaping water; and that they, therefore, furnished argument for the existence, at a great depth, of an underground channel connecting with the surface-waters at some point. The bore ("Corella No. 1") is 943 feet deep. Some of the fishes had empty eye-sockets, and others protruding eyes. Those that possessed the latter had just the appearance of deep-sea fishes, which, having suddenly come to the surface, had become affected by the internal gases expanding and getting behind the eyes. Some, which had not the eyes bulging in their present condition, showed distinct signs that this had previously taken place, the eye being sunken and loose-looking. When the bulged eyes were submitted to pressure, they immediately collapsed. In some, one side showed an almost normal eye, while the other exhibited a smooth, empty eye-socket. In cases like the latter, the eye had, apparently, suddenly burst, the lens being thrown out, and the remains of the eye had simply "dried up"; a smooth skin (without any signs of a lesion) then lining the socket. The opinion was expressed that these fishes did not live, breed, and "have their being" in subterranean depths, but that they had got into the artesian water by some subterranean channel *within the lifetime of each individual*, and, in some cases, fairly recently. *Therapon unicolor*, even as a normal surface-fish, had a highly remarkable distribution in Australia, finding its way into the most unlikely places by, at present, unknown means. A knowledge of the spawning-habits would probably throw some light on this, but at present nothing is known.

Mr. T. Steel exhibited specimens of one of the common small clay-nest-building wasps, *Alastor eriurgus* Sauss., from Brisbane, together with the brood-nests which the insect had constructed out of the gum of the Mango tree instead of the usual clay. When gathered, the gum is soft and plastic, but, after a time, becomes exceedingly hard and tough, with the result that when the wasps emerge from the pupæ they are unable to cut their way out of the gum-cells and so perish. Numbers of dead wasps were to be found within the gum-cells.

Mr. R. H. Cambage exhibited, for Mr. J. H. Maiden, portion of a flowering branch of *Eucalyptus leucoxylon*, F.v.M., collected by Mr. Osborne Wilshire, at Deniliquin, where it is locally known as "Bastard Gum." This is the common "Blue Gum" of South Australia, and the "Blue Gum" or "White Ironbark" of Victoria; but the first occasion on which it has been recorded for New South Wales. Of course *E. sideroxylon* A. Cunn., erroneously included by Mueller under *E. leucoxylon*, is common enough in New South Wales.

Mr. T. Harvey Johnston recorded the occurrence in New South Wales, of the following Entozoa, specimens of which were exhibited:—(1) *Tænia solium* Linn., from man, a very rare parasite in Australia, this being the first recorded occurrence. (2) Its cystic stage, *Cysticercus cellulosæ* Rud., encysted in the muscle of a pig, this being the first Australian record of it. (3) *Tænia saginata* Goeze (*T. mediocanellata* Kchm.), the unarmed human parasite which is rather uncommon; this is the first record for New South Wales, and the second for Australia. (4) *Dibothriocephalus latus* (Linn.), also from man, this constituting the only Australian record of a tapeworm commonly met with near the Baltic Sea; probably taken from a foreigner who contracted it elsewhere. (5) *Moniezia alba* Perr., from the intestine of sheep in the New England district; it has not been noted before from Australia. (6) *Schistosomum hæmatobium* Bilharz, the ova of which were taken in Sydney from a returned South African Soldier; this trematode has been recorded twice previously from New South Wales. (7) *Ascaris lumbricoides* Linn., from man, the first record for New South Wales and the second for Australia; it is fairly common. (8) *Oxyurus vermicularis* Linn., from a child; only once previously noted from Australia (New South Wales), though it is frequently met with. (9) *Trichocephalus trichiurus* (Linn., syn. *T. dispar* Rud.), from man; this is the first record for this State.

Mr. Tillyard exhibited a series of four adults of *Camacinia Othello* ♂, a beautiful dragonfly from Cooktown. The specimens exhibited were taken by Mr. E. A. C. Olive, of that town, and are the only ones known besides the type-male, and a pair from Prince of Wales' Island, Torres Straits.

Mr. C. F. Laseron, by permission of the Curator, Technological Museum, exhibited a series of Graptolites from a new locality near Cooma. The specimens were found in a black slate, outcropping on a creek which crosses the Adaminaby Road, 11 miles from Cooma. The fossils are well preserved as white films, which show out prominently against the dark colour of the slate. The chief genera represented were *Diplograptus*, *Climacograptus*, and *Dicellograptus*. The strata of the locality are probably a northern continuation of those of the Berridale locality, from which Graptolites have been recorded. An interesting fossil Pelecypod, belonging probably to a new genus, was also exhibited. This specimen was collected from the Wandrawandian Series at Burrier, on the Shoalhaven River.

Mr. A. A. Hamilton exhibited specimens of two plants, *Hibbertia sericea* R.Br., from Yowie Bay (A. A. Hamilton; November, 1908), and *Cassinia quinquefaria* R.Br., from Cook's River (A. A. Hamilton; January, 1908: collected also at Kogarah by J. H. Camfield; January, 1894), not previously recorded from the Port Jackson District.

Mr. A. G. Hamilton showed what appeared to be a large casting of an earthworm of considerable dimensions, collected under an overhanging sandstone rock at Willoughby, on the surface of sandy soil a few inches deep, with a subsoil of white clay. Also a branchlet of a Casuarina growing on a sandhill near the beach at Corrimal, remarkable for the fact that the rudimentary leaves, instead of being arranged in whorls, formed a spiral extending the whole length of the branchlet; the grooves following the same spiral (spiral torsion). Sections for the microscope of the spiral branch, and of a normal branch were also exhibited, showing that the fibrovascular bundles as well as the sclerenchyma were also arranged in a spiral manner, instead of straight up and down the branchlet.

NOTES ON AUSTRALIAN *COLEOPTERA*: WITH DESCRIPTIONS OF NEW SPECIES OF *TENEBRIONIDÆ*.

By H. J. Carter, B.A., F.E.S.

Notes on Synonymy and Distribution.

The following notes were taken partly during my late visit to Europe, especially to the Museums of Brussels, Paris, London, and Oxford. The difficulty of travelling, even with a few cases of insects, restricted my comparison of specimens with types to those in the Natural History Museum, South Kensington, only. My notes refer only to the three families *Buprestidæ*, *Tenebrionidæ*, and, very briefly, *Cerambycidæ*.

BUPRESTIDÆ.

Cyphogaster MacFarlandi C. O. Waterh.—Specimens from Cairns differ chiefly from *C. venerea* Thoms., in having a lateral yellow vitta on the elytral basal half, which *C. venerea* lacks.

Astræus pygmæus van de Poll, is not a synonym of *A. Samouellei* Saund., as suggested by the Rev. T. Blackburn (these Proceedings, 1889, p.1256). *A. pygmæus* is much smaller, a considerable series collected by myself, from Sydney and the Blue Mountains, only varying from 4 to 5 mm. in length, while *A. Samouellei* Saund. (=*A. Mastersi* Macl.) measures from 8 to 9 mm.; and the strong differences in the markings, pointed out by van de Poll, hold true (Notes from Leyden Mus. Vol. viii., p.170).

Melobasis speciosa Blackb.=*M. gratiosissima* Thoms.—This synonymy is based on named specimens in the Kerremans Collection, lately acquired by the British Museum, compared with a specimen named for me by Mr. Blackburn. Thomson's name has priority.

Neocuris Mastersi Macl.=*Stigmodera liliputana* Thoms.=*S. ocularis* Kerr.—I have long had little doubt but that the first-named species from Gayndah (of which I have a specimen, identified by Masters, from Gosford, N.S.W.) was a Stigmodera. Macleay's name being the older, a difficulty arises, since *S. Mastersi* is already a nom. præocc. There remains the alternative of using Thomson's name, *S. liliputana* Macl. (*nec* Thoms.) Mr. Blackburn has already pointed out the synonymy of *S. liliputana* Thoms., with *S. ocularis* Kerr.(Trans. Roy. Soc. South Australia, 1900, p.42).

Stigmodera uniformis Kerr.=*S. graphisura* Thoms.– I have not seen Thomson's type, but it is scarcely possible to doubt this synonymy. I have specimens from Sydney, and from the Blue Mountains, which have been compared with Kerremans' type, and which also exactly fit Thomson's description. Thomson's publication was the earlier.

Stigmodera pallidipennis Blackb.=*S. mustelamajor* Thoms.= *S. gibbosa* Macl.—It appears to me that Mr. Blackburn's species is but a well marked local variety of *S. mustelamajor* Thoms., so far as the less widened prothorax goes; but the colouring is so variable in this species, especially in the metallic markings of the prothorax, that little can be deduced from this. I have specimens under the first name from South Australia; and of the second, from Queensland, given me by Mr. G. Masters. I have seen specimens also from the Blue Mountains, N.S.W. Of the identity of *S. mestelamajor* Thoms., with *S. gibbosa* Macl., there is no doubt.

Stigmodera subpura Blackb.=*S. postica* Thoms.—I have specimens of this, taken by myself in Sydney, and kindly identified by Mr. Blackburn as *S. subpura*, which exactly correspond to Thomson's description. In some specimens the "tache noire postérieure" is absent. Thomson's name has the precedence.

Stigmodera vigilans is *not* a synonym of *S. rectifasciata* Saund., as suggested by Mr. Blackburn (Trans. Roy. Soc. South Austr., 1900, p.42). I have specimens of *S. vigilans* Kerr., compared with type, taken in the Blue Mountains; while *S. rectifasciata*

Saund., is a fairly common Sydney species. In *S. vigilans* the size is smaller, the sides more parallel, the apical excision smaller, while the arrangement of the fasciæ is different The basal fascia in *S. vigilans* is broader, nearer the base, and more continuous on the sides than in *S. rectifasciata*; the middle fascia is also continuous in its full width to the sides, whereas in Saunders' species it either does not meet the sides (as in fig. Journ. Linn. Soc. 1868) or is much narrowed in that region.

S. bicincta Boisd.—In Saunders' Catalogue, as also in Gemminger and Harold, this species is placed as a synonym of *S. bicingulata* Lap. et Gory. Masters' Catalogue has followed this, though Mr. Masters tells me that this is a mistake And I have two distinct species, identified from the Macleay Museum as (1) *S. bicincta* Boisd., having the elytral intervals moderately raised, and each elytral apex tridentate, the two interior teeth close together, and longer than the exterior. (2) *S. bicingulata* Lap. et Gory, having the elytral intervals strongly costate, and each elytral apex bidentate, with the exterior tooth much the longer. I carefully examined the specimens in the Hope Museum, Oxford, and took drawings of the elytral apices of the two species labelled as above. According to the Hope specimens, the Macleay Museum has the labels reversed. What I have described above as (1) is *S. bicingulata* Lap. & Gory, while (2) is *S. bicincta* Boisd.

Germaria casuarinæ Blackb.—I have little doubt but that this is the insect described as *Aphanisticus liliputanus* Thoms.; but the entirely misleading and inadequate description is a strong justification for Mr. Blackburn's redescription. If, however, this synonymy is sustained, it must be known as *Germaria liliputanus* Thoms.

Alcinous minor Kerr.—I have a single specimen of this interesting species, described as from New South Wales. My insect, identified by Mr. Waterhouse, was sent to me by Mr. Dodd, from Kuranda, Queensland.

Stigmodera Helmsi Carter.—I took a good series of this Buprestid in the Victorian Alps, above 5000 feet, at the St. Bernard Hospice, in January of the present year. They were feeding on the clumps of Aster flowers (*Olearia stellulata*). Otherwise only recorded from Kosciusko.

Pteroheleus Guerinii Brême.—I have little doubt but that this is the same insect described by Mr. Blackburn as *P. ventralis* (Trans. Roy. Soc. South Australia, Vol. xxx., 1907, p. 294). Several specimens of this apparently common insect were given me by Mr. Giles of the Zoological Gardens, Perth. On my visit to the Hope Museum, Oxford, I saw the specimen of *P. Guerinii* mentioned in De Brême's monograph, and which may therefore be taken as a cotype. Unfortunately I had not my own specimens with me for comparison, but the measurements and facies so agreed with my specimens that an examination of these a few days later satisfied me as to their identity with Hope's specimen. On my return to Australia Mr. Blackburn identified these as *P. ventralis*.

There is a curious mistake in De Brême's description (Mon. des Coss. p.36) in which the dimensions are given as $17 \times 12\frac{1}{2}$ mm., while the figure (Pl.ii., fig.3) measures 28×12 mm. If one reduces this length to 17 mm., the proportional breadth would be $7\frac{2}{7}$ mm. My own measurement of Hope's specimen is 18×8 mm, while Mr. Blackburn's dimensions for *P. ventralis* are $8 \times 3\frac{4}{5}$ l. De Brême's figure is thus correctly proportioned, while the width given under the description is a manifest error. Three specimens I now have, vary in length from 16 to 18 mm., and in width from 7 to $8\frac{1}{2}$ mm. De Brême gives no locality. Hope's specimen is labelled Australia, but, as many of his Tenebrionidæ are from West Australia, there is at least the probability of this being the correct locality, especially as the insect I refer to is common round Perth. Mr. Masters gives Tasmania as the habitat of *P. Guerinii*, but there is, I believe, no authority for this.* I cannot agree with Mr. Blackburn's suggestion that *P. Guerinii* Brême, may be synonymous with *P. tristis* Germ., since the dimensions of the latter are given as $8\frac{1}{2} \times 5$ l., evidently a much broader

*A non-pustulose insect from Tasmania, certainly *not P. Guerinii* Brême, is labelled so in the Australian Museum. This may be the origin of the locality-reference in Masters' Catalogue.

insect; also it is said only to be "apicem versus et lateralibus seriatim et remote subtiliter granulatis," while Hope's insect and my specimens have the elytra plainly and rather closely granulated from base to apex of elytra

TENEBRIONIDÆ.

Phycosecis litoralis Pasc.=*P. algarum* Pasc.—Mr. Champion has pointed out the fact that this genus cannot be retained in the Heteromera (Trans. Ent. Soc. Lond. 1894, Part ii., p.364). I compared the types of these two species with specimens taken by myself at Sydney and Fremantle. The differences between the two type-specimens are, I think, due only to abrasion. Fresh specimens are covered with a white squamosity, easily removed, and in this case the insect is of a dirty brown colour.

Dipsaconia (*Endophlœus*) *australis* Hope.—The distinction between this and *D. pyritosa* Pasc., is little known to Australian collectors. *D. australis* is of a lighter colour, with distinctly costate elytra; while *E. pyritosa* is much darker, with shorter hairs, and elytra without distinct costæ. The first-mentioned is synonymous with *D.Bakewelli* Pasc., (*fide* Champion, Trans Ent. Soc. Lond. 1894). My specimens of *D. australis* are from Tasmania; those of *D. pyritosa* are from Muswellbrook, N.S.W. The type is from Melbourne.

Arrhenoplita pygmæa Champ.: *Corticeus australis* Champ.: *Diphyrrhyncus ellipticus* Champ.: *Ectyche cœrulea* Champ.—I am indebted to the generosity of Mr. Champion for cotypes of these.

Helæus.—No identification of species in this genus should depend on the right or left prothoracic process overlapping. Thus in the Paris Museum, of two specimens labelled *H. perforatus* Latr., the type has the *right* overlapping the *left*, the second specimen has *left* over *right*. Of thirteen specimens in the British Museum labelled *H. perforatus* Latr., five have *left* over *right*, seven have *right* over *left*, while in one case these processes do not meet. Again, of nine specimens marked *H. colossus* Brême, six have *left* over *right*, while three have *right* over *left*.

Onosterrhus.—No Australian collection had, to my knowledge, an identified specimen of this genus. I was therefore glad to be able to determine two species of my own, by comparison with Bates' types. Its form is in general that of a small *Hypocilibe*; for structural differences see Trans. Ent. Soc. Lond. 1872, p.277.

Amphianax subcoriaceus Bates.—A smaller and narrower form, near *Agasthenes*, with the prothorax contracting in front.

Nyctozoilus Deyrollei Bates.—The author was unable to give a more definite habitat than Australia. I have a specimen given me by Mr. R. Helms, from Fern Hills, Victoria, which corresponds to the type.

Pediris (Upis) sulciger Boisd.—I have a specimen of this, taken by Mr. Hacker, in the Coen district, Cape York. This is the first record of its capture in Australia, though it appears to be common in New Guinea. Boisduval's locality is Amboyna.

Menephilus cyanipennis Hope, is probably a large specimen of *N. cœrulescens* Haag-Rut. Hope's type measures 12 mm. long, but seems otherwise identical, though unfortunately I had no specimens of *N. cœrulescens* at hand in my Oxford visit.

Menephilus convexiusculus Hope, is probably identical with *Meneristes servulus* Pasc.

Lepispilus stygianus Pasc.—After a close examination of the type (in a bad condition) I see no reason for altering my opinion as to the distinction of this species from *L. sulcicollis* Boisd., as expressed (these Proceedings, 1906, p.258). I took nine specimens of this species in the Victorian Alps, in January, 1909, identical with the Kosciusko insect and equally differentiated from *L. sulcicollis.*

Cardiothorax.—An examination of Bates' types has confirmed my opinion as to the synonymy of *C. fraternalis* Bates, *C. pithecius* Pasc., *C. errans* Pasc., and *C. valgipes* Bates (these Proceedings, 1906, p.237).

C. brevicollis Haag-Rut.—A specimen in Bates' Coll., labelled "Compared with type by Dr. Rogenhofer" is quite black, without hind angles to the prothorax, and is *not* the species so named in the Macleay Museum, as noted in my paper (*supra*).

Coripera Morleyana Cart., seems to be only a variety of *C. Mastersii* Macl., differing only in its possession of a light-coloured band round the elytra. The wide distribution is here worthy of note, *C. Morleyana* being taken on Mount Irvine (Blue Mountains), while *C. Mastersii* is from Gayndah. The varietal names should be preserved.

Chariotheca cupripennis Pasc., not hitherto recorded from Australia. I have two specimens from Cairns, which are identical with Pascoe's type from New Guinea.

Adelium forticorne Gebien (Fauna Süd-west Aust. Hamburg, 1908, p.343).—There is little doubt but that this is synonymous were *A. vicarium* Pasc., the originals of which, taken at Albany, with sent by Mr. Masters to Pascoe. I have cotypes of these which were also compared with Pascoe's type. Pascoe pointed out the subclaviform antennæ, also its similarity to *A. succisum* Pasc., (a synonym of *A. angulicolle* Castel., to which, Gebien says that his species is extremely similar). The only difference remarked by Herr Gebien between his species and *A. vicarium*, is the more strongly punctured head and prothorax; differences which may well be accounted for by the strong variations to be found in this character throughout the genus, and which may well be consistent with Pascoe's very meagre description.

CERAMBYCIDÆ.

The following six species of longicorns were identified by me in the British Museum. This is, I believe, the first record of them from Australia. They were all taken by Mr. H. Hacker in the Coen District, Cape York.

Aconista alphoides Pasc.

Gnoma affinis Guer., Voy. Coquille, 1830, p.136, pl.vii., fig.10, N. Guinea.

Monohammus captiosus Pasc., N. Guinea.

M. longicornis Thoms., N. Guinea.

M. magneticus Pasc.(?), N. Guinea.

The above, together with the two Tenebrionids mentioned, and the Cicindelid (*Tricondyla aptera*) recorded by Mr. Sloane, give further evidence of the considerable overlapping of the insect-fauna of the Austro-Malayan regions with the true Australian fauna. The well known *Glenea picta* Fabr., is another example of this invasion.

Momisis melanura Gahan (Trans. Ent. Soc. Lond. 1901, pl, iv. has been identified for me by Mr. C. J. Gahan; also from Cape York, taken by Mr. Hacker.

Zoedia longipes van de Poll (Tijdschr. voor Ent. xxxiv., p.222, pl.13, 1891)—Identified by Mr. Gahan, from specimens taken by me near Wollongong.

STYRUS LATIOR, n.sp.

Elongate-ovate; above and beneath opaque black; antennæ, palpi, and tarsi fuscous.

Head somewhat triangular, labrum strongly emarginate, truncate and fringed with upright reddish hairs; epistoma rather flat, straight in front, rounded at sides, limited behind by sinuous impression continued obliquely to sides in front of antennal orbit; front widely channelled at centre with transverse impression between the eyes, the whole finely punctate and clothed with a rough derm; antennal orbits gradually widened and raised behind; antennæ with third joint longer than fourth and fifth combined, and cylindrical, joints 4-7 obconic, 8-11 nearly round and successively larger. *Prothorax* convex, wider than long (5 x 6 mm.), wider at base than apex (in the ratio 10 : 7), greatest width distinctly behind the middle, squarely emarginate anteriorly, front angles enclosing head to eyes, and acute, apex with thin upturned border at angles only; sides widely rounded, sinuate anteriorly, abruptly so posteriorly, hind angles widely acute (about 80°) and slightly directed outwards; lateral border thickened, upturned on anterior half and crenulate; base truncate and without raised border. Disc very uneven, with moderately wide lateral foliation, central line only indicated by large elongate fovea near base and a faint line near apex; and, like the head and elytra, covered with a close derm, beneath which are indications of punctures; faintly strigose at base and sides, and with irregular longitudinal foveæ near sides. *Elytra* slightly convex, broadly ovate, wider than and just twice as long as prothorax; shoulders rather squarely rounded and wider than prothorax at base, sides gradually widening behind till near apical declivity; surface without definite costæ, or with two ill-defined costæ on each elytron, coarsely and irregularly alutaceous, with reticulation larger at base, becoming obsolete at apex, intervals coarsely foveate-punctate; lateral border narrow, only evident from above at shoulder and apex, and without lateral gutter; a single row of punctures on sides of the same size as the punctures on the intervals. Prosternum trilobed, produced a little backward and rounded at apex; the whole underside, with femora and tibiæ, finely and rather closely punctured; all tibiæ straight and minutely spinose at apex. Tarsi and extreme apex of tibiæ sparsely clothed with pale reddish hairs. *Dimensions*—16 × 8·3 mm.

Hab.—Walcha, New South Wales.

Two specimens kindly given to me (and collected) by Dr. E. W. Ferguson, one in a mutilated condition and without tarsi. The type-specimen has moderately dilated tarsi, but is without any marked sexual characters. The species differs considerably from *S. elongatulus* Macl., and *S. clathratus* Blackb., in its widely rounded prothorax, more robust and dilated body, and irregular reticulate sculpture, as compared with the distinct costæ of the latter two species.

OSPIDUS PAROPSOIDES, n.sp.

Ovate, very convex, dull metallic purple-bronze.

Head and antennæ in structure similar to *O. chysomeloides* Pasc., but more closely and coarsely rugose, and with the whole surface less nitid. *Prothorax* more than twice as wide as long (3 × 7 mm.), widest at base, apex emarginate, anterior angles rounded but protruding considerably in front of the eyes; explanate margins flat, wide and rugose. Disc very convex, more finely and closely rugose than margins, lightly impressed in the middle and near the base on each side of middle; base bisinuate;

a narrow border only perceptible at apex. *Elytra* closely applied to, and of the same width as, prothorax at base, shoulders rectangular, sides curved and widened to two-thirds of the length, finely bordered and more narrowly explanate than in *O. chrysomeloides*. Disc very convex, with greatest height about middle, there slightly gibbous; humeral callus distinct; with lines of large punctures, irregular near suture, regular towards sides of disc, obsolete at apex and margins, the intervals somewhat vermiculately rugose; also two indistinct costæ on each elytron, namely, a short scutellary costa, and one on each side of suture continuous almost to apex. The whole underside and legs clothed with fine recumbent pale-coloured down. *Dimensions*—11 × 8 mm.

Hab.—North Queensland.

I have a single specimen, received some time ago from Mr. H. Hacker (probably from Coen River). There are also specimens in the Macleay Museum. It differs widely from *O. chrysomeloides* Pasc., and *O. gibbus* Blackb., in its smaller size (Pascoe gives 6 lines for his species; my own three specimens of *O. chrysomeloides* measure 15 mm.), duller and more metallic colour, and coarser sculpture throughout.

Note.—In Masters' Catalogue a double misprint has occurred, first in the spelling of *Ospidus*, secondly in giving Castelnau as the author of this genus instead of Pascoe.

Agasthenes Goudiei, n.sp. (Text-fig. 1).

Elongate-ovate, subparallel, black, moderately nitid, antennæ and tarsi piceous-black, the latter, together with apex of tibiæ, clothed with reddish pile.

Head : labrum strongly produced, punctulate, rounded at sides, and showing membranous hinge; epistoma truncate, bluntly subrectangular at sides, defined behind by bisinuate line indistinct in the middle; antennary orbits rising and widening in a regular curve towards base (not subparallel as in *A. Westwoodi* Bates), front and epistoma finely and rather distantly punctulate, eyes large, transverse and flatter than in *A. Westwoodi*; antennæ at rest extending nearly to base of prothorax, third joint cylindrical, longer than fourth and fifth combined, 4-8 obconic, tenth spheroidal, eleventh much longer than tenth, ovoid and flattened, basal joints distinctly punctured, apical joints pilose. Tooth of submentum small and conical, submentum opaque and strongly punctured. *Prothorax* transverse (4 × 6·5 mm.), length measured in the middle, greatest width behind the middle, apex strongly arcuate-emarginate, anterior angles acute, produced forward beyond the eyes and outwards and a little reflexed; sides sinuate anteriorly, strongly widened towards basal third, then more abruptly sinuate towards hind angles, these acute and outwardly directed; base bisinuate, wider than apex, base and apex narrowly margined; sides with uniformly thickened upturned margins (less thickened and more uniform than in *A. Westwoodi*), not explanate nor distinctly channelled within. Disc smooth, rather flat (much less convex than *A. Westwoodi*), with obscure traces of middle line and two large shallow depressions, one on each side of middle near base. *Scutellum* rather widely triangular and raised (less transverse than in *A. Westwoodi*). *Elytra* three times the length of prothorax, and wider than it (12 × 8 mm.), shoulders obtuse and subangulate, sides subparallel at basal half, then slightly widened; sides narrowly margined and channelled, and evident throughout from above, with a row of large marginal punctures on basal half, the whole surface irregularly and rather finely punctured, with three equidistant obscure costiform impressions on each elytron, becoming obsolete at base and apex, surface depressed near shoulders. *Prosternum* transversely strigose, prosternal process carinate at sides with apex produced, rounded and reflexed; *mesosternum* strongly carinated in the middle, *metasternum* channelled, *abdomen* with first two segments longitudinally strigose, two apical segments finely punctured, Femora and tibiæ punctured, the latter very little enlarged and shortly spinose at the apex, with a thin line of red tomentum on the inside

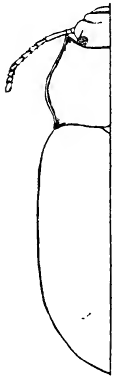

Fig. 1.

on apical half. Structure of tarsi as in *A. Westwoodi*, but colour piceous (in *A. Westwoodi* reddish). *Dimensions*—18 x 8 mm.

Hab.—Sea Lake, Victoria.

The unique type-specimen, probably ♀, has been sent by Mr. J. C. Goudie, taken by that gentleman during a flood. By the generous wish of Mr. Goudie, it, together with the type of *Hymæa laticollis* Cart., will be presented to the National Museum, Melbourne, in the cause of entomology; an example of public spirit much to be applauded. It is easily distinguished from its congeners by its flat and parallel form, and different structure of submentum, *inter alia.*

AGASTHENES FRENCHI, n.sp (Text-fig. 2).

Moderately elongate, oval, opaque-black; antennæ, palpi, and underside deep reddish-brown.

Head: labrum not prominent, mandibles stout and triangular, epistoma subtruncate in front with sides parallel, angles subrectangular, scarcely separated from front by faint impressions at each side; antennal orbits widely rounded, extending outside the eyes, ocular furrow deeply impressed, extending about two-thirds of distance from the eye to epistoma; eyes larger than in *A. Westwoodi* Bates, front rather flat, and with epistoma closely punctured and finely longitudinally rugose. Antennæ not quite reaching base of prothorax, third joint longer than fourth and fifth combined, joints 4-7 somewhat cylindrical, 8-10 shorter and wider, eleventh longer than tenth, ovoid. *Prothorax* convex and transverse (5 x 7·5 mm., length in the middle) arcuate-emarginate in front, without marginal border, front angles prominent, acute, (less acute than in *A. Westwoodi*), directed forwards, sides anteriorly rather straight, very gradually widening till near base, greatest width near base, then rather abruptly but evenly rounded and strongly constricted; hind angles rectangular, dentate deflected and twisted, so that basal edge is almost vertical;

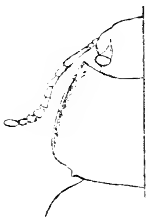

FIG. 2.

lateral border scarcely differentiated from disc, recurved towards base, and, with it, closely, finely, evenly and distinctly punctured; base subtruncate, very narrowly bordered. Disc convex, a little foliate at the sides, these hollowed near base, flatter and more horizontal anteriorly. Central line very feebly indicated by smooth interval on centre; a transverse impression near to and parallel with base. *Scutellum* widely transverse, triangular, punctulate, carinate in the middle, raised anteriorly and strongly depressed behind. *Elytra* (10·5 × 8·5 mm.) moderately convex, widely ovate, epipleural border a little raised at shoulders, these rounded: slightly narrower than prothorax at base, then rather widely rounded, greatest width about middle, bluntly tapering at apex. Sides narrowly bordered, this border not continued on base, and throughout seen from above, with narrow horizontal margin, with a row of evenly placed, rather distant and not large punctures continued almost to apex. Disc smooth, except for faint indications of three subobsolete costæ quite disappearing on apical declivity, and even, minute, rather close surface-punctures. Submentum coarsely punctured, with prominent triangular tooth, gula without longitudinal furrow, prosternum and underside of femora coarsely, abdomen more finely, closely punctured. Tibiæ straight and feebly spinose at apex, first joint of posterior tarsi as long as the rest combined. *Dimensions*—16·5 × 8·5 mm.

Hab.—Murchison District, West Australia.

A single specimen, kindly presented by Mr. C. French, to whom I dedicate it. Easily distinguished from *A. Westwoodi* Bates, by shorter, wider form, and the very different prothorax (wider anterior angles, thin and opaque lateral border, and general shape). The form of prothorax is somewhat trapezoidal, sides almost straight, gradually widening from apex to base, so that the maximum width is almost at the hind angles. It seems to me a mistake to define the genus of a group like the *Nyctozoilides* as rigidly in smaller details as Bates has done in the case of *Agasthenes*, as almost every new species would require a new genus. In this case Bates' generic diagnosis must be slightly modified to include *A. Frenchi*, since (1) the gula is without a longitudinal furrow; (2) the antennal orbits are rounded; (3) the elytra are without any basal margin. Type in the author's coll.

AGASTHENES STEPHENI, n.sp. (Text-figs. 3*a*-3*b*).

Elongate, ovate, black, smooth, opaque; labrum and oral organs piceous; antennæ piceous at base, lighter towards apex.

Head wide; labrum prominent, transverse with rounded angles, clothed with reddish hair; antennæ with first two joints short, third not quite so long as the fourth and fifth combined, joints 3-7 subconical, 8-11 much shorter, subspheroidal and flattened; front and epistoma finely punctulate. *Prothorax* strongly transverse and moderately convex, much wider than long (6 x 10mm.), arcuately emarginate in front, front angles scarcely acute, rather bluntly rounded, sides gradually widened to beyond the middle, but constricted near base, hind angles acute, directed obliquely backward, lateral margins rather wide, edges strongly thickened; apex bordered only near anterior angles, base with narrow border throughout. Disc nearly smooth, towards the sides minutely punctured (not visible to the naked eye). *Scutellum* convex, very widely transversely triangular. *Elytra* convex, elongate-ovate, smooth except for the single row of punctures at margin, not extending to apex; wider than prothorax at base. At each side a shallow furrow from shoulder to apex; shoulders not prominent, margins reflexed throughout, especially at shoulders. Beneath black: abdomen with faint longitudinal wrinkles; submentum finely punctulate, metathorax and abdomen smooth; femora finely punctured, tarsi and tibiæ (near apex) clothed with golden tomentum. Intercoxal process widely curvilinear and subtruncate. *Dimensions*—Long. 21-22 mm.; lat. 10-11·5 mm.

Fig. 3*a*. ♂

Fig. 3*b*. Anterior tarsus. ♀

Hab.—Forbes, Weddin Forest, Canbelego, N.S.W.

Five specimens are before me; two, taken by Mr. Cox from Weddin Forest, near Young, are, I consider, males, as also one taken by Mr. P. Shaw at Canbelego; while two from Forbes, sent by Mr. Alfred Stephen, are both female. If I am correct in this, the male has a remarkable sexual distinction in the abnormal enlargement of the basal joint of the anterior tarsi, which is not found in the female. The same joints of the intermediate tarsi are enlarged to a much less degree in the same specimens. The Forbes (♀) specimens are wider and less parallel in form, with a slightly steeper apical declivity. I do not think it likely that there are two species in the above, the only differences (noted above) being entirely referable to sexual characters.

A. Stepheni is, by its more convex form and more rounded front angles of prothorax, intermediate between *Agasthenes* and *Hypocilibe*; but I am sure that no student of the Tenebrionidæ could place it in a different genus from *A. Westwoodi* Bates, although one modification of Bates' generic diagnosis is necessary for its reception, *i e.*, the very acute front angles in *A. Westwoodi* should be considered as a specific rather than a generic character. Types in author's coll.

Var. i. a ♀ specimen from Mildura, Victoria, is of shorter and more convex form, but is otherwise identical with the above.

Agasthenes Westwoodi Bates.

I have received an undoubted specimen of this rare insect from Mr. H. Giles of the Zoological Gardens, Perth, taken at Kellerberrin, West Australia. As the unique type, in the British Museum, is without palpi, tarsi, and the five apical joints of the antennæ, I will describe these. Palpi and antennæ chestnut-red; the maxillary palpi long, with apical joint narrowly cultriform. Antennæ with first joint short, thick and cylindrical; second very short and bead-like, joints 3-7 subconic, third about as long as the fourth and fifth combined, joints 8-11 much shorter than the preceding, slightly thickened, more hairy and of a paler red colour, apical joint prolate-spheroidal. *Tarsi*: anterior and intermediate, with basal joint as long as, but not wider than, the second and third combined, the claw-joint much the longest. Posterior with basal joint as long as the rest together, claw-joint shorter than that of the anterior or intermediate tarsi. Probably ♀.

ÆTHALIDES PUNCTIPENNIS Bates.

(Ent. Mo. Mag. x. 1873, p.50.)

It seems probable that Mr. Bates' locality, given as West Australia, is incorrect. I have three specimens, two of which I compared with Bates' type. These two were given me by Mr. Sloane, without locality-labels, probably from Mulwala, Murray River. I have since received a third specimen from Mr. Goudie, taken at Birchip in N.W. Victoria; while two specimens in the Macleay Museum are labelled Murray R. It is possible, but improbable, that this genus has an extended range westward. This genus and species were omitted from Mr. Masters' Catalogue.

ÆTHALIDES COSTIPENNIS, n.sp. (Text-fig. 4)

Elongate-ovate, convex, prothorax dull black, elytra slightly shining.

Head: labrum emarginate, truncate, and closely setiferous; epistoma truncate, not raised, and separated from front by a well marked curved impression; antennal orbits sinuously rounded, and little raised; front and epistoma distinctly and not very closely punctulate. Antennæ: third joint as long as fourth and fifth combined, joints 4-7 longer than broad, 8-10 almost globular, 9th and 10th smaller than 8th, apical joint longer than the tenth, ellipsoidal. *Prothorax* transverse, length to width in the ratio 5 : 8, widest at middle, wider at base than at apex (7 and 5 mm. respectively), anterior angles prominent and obtuse, sides rather widely rounded and a little explanate; posterior angles obtuse and slightly deflected. Sides and front angle strongly margined and reflexed, the margin becoming obsolete at base and apex. Base widely lobed, this lobe emphasised by a transverse impression not far from base. Disc rather opaque

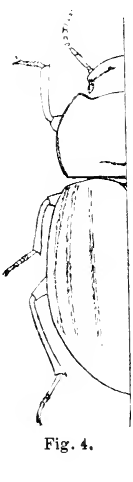

Fig. 4.

and punctured like the head. The narrow explanate border slightly rugose. Scutellum widely transverse. *Elytra* oblong-ovate, broader than prothorax at base, shoulders widely rounded, with epipleural fold forming a narrow upturned border; sides subparallel till near apex, apical declivity steep. Disc coarsely and irregularly punctured, most strongly on the sides and middle, punctures becoming less distinct towards apex; interstices convex and alutaceous; each elytron with three well marked costæ about equidistant from each other and from the sides; of these the first two approach one another near the base (in one specimen, out of five under observation, they actually meet), the third starting from the shoulder, all three becoming obsolete on apical declivity; the suture itself forming a fourth double costa which bifurcates near the scutellum, the branches leading off to join the first costa at the base. Beneath black, shining; tibiæ and tarsi clothed with fulvous hair. *Dimensions*—18-20 × 9-10mm.

Hab.—Cootamundra, N.S.W.; taken by my son, E. M. Carter.

Evidently an ally of *Æ. punctipennis* Bates, of which I have specimens which I have compared with Bates' type. From this species the chief differences are (1) greater size, (2) wider margin of prothorax, (3) narrower and less vertically placed head, (4) much coarser reticulation, and well marked costæ of the elytral sculpture.

The only sexual difference that is easily apparent is the slightly enlarged basal anterior tarsus of the male. In the genus *Æthalidès* the submental tooth is not so definite as in *Hypocilibe*; and, if my diagnosis is correct, the submentum should be rather described as lobed than toothed. The mandibles are very wide at the base, concave, channelled in the middle, and margined at the sides, rather abruptly narrowing to the apex. In *Hypocilibe* the mandibles are generally much narrower at the base, and scarcely, if at all, concave. Type in author's coll.

ÆTHALIDES MARGINICOLLIS, n.sp. (Text-fig. 5).

Male oblong-oval, convex, black, slightly shining (more so than in *A. punctipennis* Bates).

Head: labrum emarginate, punctate, truncate with rounded angles, clothed at apex with reddish hairs and separated from the epistoma by membrane; mandibles grooved and punctured above. Epistoma concave, truncate with rounded but scarcely reflexed angles; separated from the front by sinuate impression, and with the front closely and finely punctate; antennal orbits widened, parabolically rounded, eyes very narrow. Third joint of antennæ less than fourth and fifth combined, joints 4-7 obconic, 8-10 round, apical joint oval. *Prothorax* transverse, less convex, but smoother than *A. punctipennis*, very minutely punctured, punctures more evident towards sides, width not quite twice the length (4·5 × 7·5 mm.), the greatest width behind the middle; front angles prominent and acute, sides moderately rounded and slightly sinuate near posterior angles, these widely acute and a little outwardly directed; base truncate. Lateral margins thick, rounded and upturned, terminated behind at the posterior angles, in front continued, *but much thinner*, to a little behind the emarginate anterior angle. Disc with slight irregular depressions near base. Scutellum very transverse and smooth. *Elytra* wider than prothorax, convex, shoulders rounded, sides a little widened towards apex, with eight indistinct costiform impressions, on each elytron including the suture which is slightly raised. Of these the third, fifth, and seventh are more prominent; between these are indistinct, irregularly placed, shallow foveate punctures, with occasional faint indications of reticulation, especially towards sides and apex. Lateral row of punctures large and close, the sides bordered throughout by a narrow upturned margin. Submentum and sternum strongly and not distantly punctured, submental tooth wide and prominent, prosternum bordered at apex by fringe of reddish hairs; episternal process wide, carinated at the sides and truncate at the apex. Abdomen longitudinally wrinkled and finely punctured. Epipleuræ nearly smooth; femora and tibiæ punctured, the latter, with the tarsi, clothed

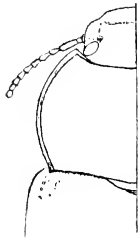

Fig. 5.

with reddish hair. Posterior basal tarsi as long as the rest combined (excluding the claws), anterior tarsi without marked sexual characters. *Dimensions*—17 × 9 mm.

♀. Longer and more parallel, anterior tarsi slightly narrower. *Dimensions* 18 × 9·2 mm.

Hab.—Birchip, Victoria, and Wimmera District; (from Mr. J. C. Goudie and Mr. C. French).

Easily distinguished from *A. punctipennis* and *A. costipennis* by its wider border to pronotum, and different elytral sculpture. The female specimen is much more nitid than the male, but this appears to be due to immersion in spirit, and is evidently a more worn specimen than the male from Birchip. The female-type has been returned to Mr. French.

ÆTHALIDES DECEMCOSTATA, n.sp. (Text-fig. 6).

May be best described by comparison with the former two species. Colour as in *A. costipennis*, opaque black.

Head in structure like *A. marginicollis*, but finely punctulate as in *A. costipennis*. Third antennal joint equal to fourth and fifth combined.

Prothorax: convexity as in *A. costipennis*, with anterior angles very acute and more prominent than in *A. marginicollis*, with sides and front angles even more thickly margined than in that species. This margin emphasised by a distinct gutter within the margin. Sides widely rounded as in *A. costipennis*, but more sinuously incurved towards the posterior angles, which are deflected and acute. *Elytra* each with five distinct, rounded costæ. The first divided by the suture, bifurcates near the scutellum, forming the triangular depression behind it, the branches scarcely reaching the base; the second and third, at about equal intervals from each other and from the the suture, join near the apical declivity, and are then merged into the indefinite rugosity of the intervals; the fourth, joined to the fifth near the shoulder, is continuous almost to the

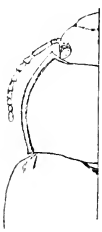

Fig. 6.

apex; while the fifth is near and parallel to the sides, becoming obsolete at the apical declivity. The intervals are coarsely and subalutaceously punctulate as in *A. marginicollis*. The basal joint of the front tarsi is distinctly longer than each of the next three. *Dimensions*—16 x 8 mm.

Hab.—Grampians, Victoria. A single specimen (♂?) from Mr. C. French. Type in the author's coll.

Byallius ovensensis, n.sp.

Differs from *B. reticulatus* Pasc., in the following particulars. *Head* more finely punctured, eyes smaller, antennæ stouter. *Prothorax* much wider at apex, with acute anterior angles much more emarginate and obliquely curved outwards; sides more sinuately widened near apex, posterior angles rectangular, but more deflected and outwardly directed. Lateral margins much thicker, shining, rounded, and less recurved. Disc flatter and much more finely punctured. *Elytra* less distinctly costate, intervals more coarsely rugose and much more finely punctured. *Abdomen* with first two segments longitudinally strigose, and, like the sternum, finely punctate. (In *B. reticulatus* the abdomen is *not* strigose and, like the sternum, coarsely punctate throughout). Legs shorter and much less strongly punctate. *Dimensions*—20 x 8 mm.

Hab.—Bright and Fern Hills, Victoria. Taken by the author. Also from Messrs. Helms and French.

The capture, by the author, of a specimen of what is evidently the true *B. reticulatus* Pasc., at Cunningham, Gippsland, has convinced me that I was mistaken in my former identification of that species. The two species are superficially so alike that, when examining the type, greater latitude for variation was allowed than I now think to be admissible. *B. ovensensis* is, therefore, the species that I compared with *B. kosciuskoanus* (these Proceedings, Vol. xxxiii., p.412). Type in author's coll.

Byallius Mastersii, n.sp.

Elongate-ovate, convex, black, pronotum opaque, elytra moderately shining, antennæ, palpi, and tarsi piceous, underside of tarsi and tibiæ clothed with golden pubescence.

Head with frontal punctures more distinct than in the former species. Antennal orbits less widely rounded, forehead more convex and rather deeply impressed by a central longitudinal furrow widening anteriorly; antennæ much slenderer, especially as to basal joints, third joint distinctly longer than the fourth and fifth combined. *Prothorax* wider than long (5 × 6 mm.), length measured at middle, very convex, anterior angles emarginate and acute, directed forwards, apex semicircular, margined only at angles, lateral borders strongly thickened and scarcely recurved, slightly sinuate anteriorly and posteriorly, greatest width about the middle; posterior angles acute and a little overlapping elytra, base closely fitting elytra and feebly bisinuate. Disc not perceptibly punctured, with central channel distinctly impressed throughout (the only case in the four known species; in *B. reticulatus* this channel is slightly indicated by a smooth line), with two large shallow elliptic impressions near centre, one on each side, and close to, the central line. *Scutellum* widely transverse and very narrow, elytra triangularly depressed behind. *Elytra* moderately convex longitudinally, strongly so transversely, sides and apical declivity very steep: at base wider than prothorax, humeral angles obtuse but distinct; sides with narrowly reverted border (only apparent at shoulders and apex when seen from above), gradually widening till near apical declivity, then abruptly narrowing, apex rounded and a little horizontally channelled in that region. Each elytron clearly, equidistantly tricostate, first costæ not reaching the base, suture itself convex (scarcely costate), space between first costæ irregularly impressed with large (and a few smaller) foveate punctures, other costal intervals reticulately, but not rugosely, foveate, with a single row of large punctures on margin extending to apex. Submentum and throat with large and rather distant, round punctures, prosternum smooth with a few transverse striæ, mesosternum carinate, closely and coarsely punctured, prosternal process bluntly produced backwards and notched on each side. Abdomen minutely punctured, with first two segments a little strigose at anterior edges. Femora finely, tibiæ (especially towards apex) coarsely punctured on the undersides. [Front tarsi wanting]. *Dimensions*—19 × 8·5 mm.

Hab.—Interior of New South Wales (Condobolin).

A specimen (probably ♀) is under examination from the Macleay Museum, through the courtesy of Mr. G. Masters. It is readily distinguished from the other three species by (1) convex and channelled head, (2) scarcely recurved prothoracic border, and acute posterior angles, with canaliculate disc, (3) narrow but very transverse scutellum, with triangular depression behind, (4) nonrugose and foveate elytra, and (5) greater convexity in both directions. Type in Macleay Museum.

Four distinct species are before me, differentiated as follows:—

1. *B. reticulatus* Pasc.—Prothorax with lateral border moderately wide and strongly recurved; disc strongly punctured (evident to the naked eye). Elytral intervals and undersurface strongly punctate.

2. *B. ovensensis* Cart.—Prothorax with anterior angles much more emarginate, lateral border strongly thickened and less recurved. Discal punctures very fine (not evident to the naked eye). Elytral intervals and under surface much less strongly punctate, first two segments of abdomen strigose.

3. *B. kosciuskoanus* Cart.—Prothorax with anterior angles not prominent, lateral border less thickened than in 2, and strongly recurved only near apex. Posterior angle widely obtuse and not deflected. Discal punctures as in *B. ovensensis.* Abdomen not strigose, but punctures finer than in 1.

4. *B. Mastersii* Cart.—Forehead and prothorax distinctly canaliculate, acute posterior angles and scarcely recurved border to prothorax. Disc smooth. Scutellum narrowly transverse and accompanying elytral depression. Elytra foveate but not rugose. The whole more convex, and apical declivity nearly vertical.

CARDIOTHORAX MIMUS, n.sp.

Elongate-ovate, depressed, blackish-brown, opaque.

Head with frontal impression almost circular, basal joints of antennæ slender, succeeding joints stouter to the apex, each joint furnished at its apex with stout whitish bristles, apical joint largest and thickly covered with such bristles. *Prothorax* cordiform, widest considerably in front of middle, anterior angles prominent and obtuse; sides widely rounded and parabolically constricted towards the base, posterior angles forming a slender process directed backwards as in *C. egerius* Pasc.; foliaceous margins wide and slightly upturned, the anterior half separated from the disc by a deep curved sulcus; border raised, not shining, throughout, most evident at apex. Disc nearly flat, central line distinct, an elongate foveate depression on each side. *Elytra* elongate-ovate, shoulders obsolete, disc rather flat; striate, with six striæ on each elytron shallowly and indistinctly punctured; intervals rough and obsoletely punctulate; margined by a strong crenulate costa, roughly punctured. Exterior to this costa, on the curved side of each elytron, are two more rows of subfoveate punctures separated from the true epipleura by a costate border less elevated than the preceding but meeting it near the shoulder and near the apex. Upper half of epipleuræ with two similar rows of punctures to the two marginal series; lower half smooth. Legs smooth, with under surface glossy black, femora unarmed. Body beneath black, smooth and opaque. *Dimensions*—14 × 5 mm.

Hab.—Tambourine Mountain, Queensland; from Mr. R. Illidge.

The above is, I believe, a female, but I have also a specimen, which I take to be a male of the same species, given me by Mr. Cox, bearing a label "Ex Coll. Froggatt," probably from the Tweed River district. This differs from the above in the following particulars, which I therefore call *var. A.*

Var. A.—Anterior angles of prothorax much more acutely and squarely produced, as in *C. egerius* Pasc. Elytral sculpture less distinct (possibly from abrasion and grease), with the outside costa obsolete, and the inside or submarginal costa less strongly marked. *Dimensions*—12·1 × 4·2 mm.

The above insects strongly resemble *C. egerius* Pasc., in colour and form, especially in the peculiarly lobate hind angle of prothorax; but they are clearly differentiated from that species in size, and in the absence of the alternate costiform intervals on the elytra which characterise Pascoe's species. I would take this occasion to add that the figure given in the Journal of Entomology for 1866 (Pl. xix., fig.4) is misleading, in that, (1) it gives an inadequate picture of the lobate hind angles of prothorax, (2) it greatly exaggerates the obovate elytra. In a series taken by myself, specimens of which I have compared with the type, none are enlarged posteriorly to the same extent as in the figure. Two specimens in my collection measured as follows: ♂.19 × 5½ mm.; ♀.20 × 6½ mm.; whereas the measurements of the figure given, if reduced to the same standard of length as my female specimen, would be 20 × 7⅓ mm.

CARDIOTHORAX CARINATUS, n.sp. (Text-fig. 7).

Elongate, black, prothorax opaque, elytra nitid, antenæ, palpi, and tarsi reddish.

Head with labrum emarginate, slightly concave in front and fringed with a few golden hairs, epistoma with front edge trilinear (*i.e.*, truncate in front, angulately rounded towards the sides); frontal impression rather square; antennæ thick and, with the palpi, clothed with short golden pile. *Prothorax* 5 × 7 mm., the length being measured along the middle, the greatest width behind the middle, the anterior angles strongly produced but rounded and reflexed at the tip, wider at apex than at base (5 mm. and 3 mm. respectively), the latter strongly bisinuate; sides widely and parabolically rounded, with edges thick, shining, not reflexed and coarsely crenate throughout except near hind angles; posterior angular process widely truncate, directed obliquely outwards; foliaceous margins wide, separated from the disc throughout by a deep curved sulcus, much wider in front than behind; median line well defined, widely channelled at the base; at each side of this is an irregular elongate depression, curved and nearly meeting behind, the insulated central part of disc raised, rugose and terminated at the apical border by two raised

Fig. 7.

triangular humps; the foliaceous sides obliquely striolated across the anterior angles. *Elytra* wider than prothorax, slightly convex, broad at the base, sides slightly dilating towards the apical third, abruptly declivous behind; a triangular depression behind the scutellum; shoulders widely rounded, with unusually strongly reflexed epipleural fold; with four shining carinate costæ on each elytron; of these the first and fourth connected near the apex, the second and third not connected, the second shorter than the third apically, and the third and fourth not reaching the base; between these (one outside) are five slightly convex intervals of a dull black becoming subobsolete towards the apex, entirely impunctate; the suture also itself shining and bicostate, though less raised than the four costæ mentioned above. *Epipleuræ* subconvex with an evident central ridge. (N.B.—In *C. crenulicollis* Bates, the epipleuræ are concave, with a central depressed line). *Abdomen* smooth and shining; *femora* transversely striolate; *tarsi* and apex of tibiæ clothed with golden hairs. *Dimensions*—20 × 7·5 mm.

Hab.—Mount Garnet, North Queensland (sent by C. French, Esq., F.L.S., of Melbourne).

This interesting ally of *C. crenulicollis* Bates, may, at first sight, be mistaken for an exaggerated variety of that species; but the striking differences pointed out in the diagnosis are evidently specific; *e.g.*, the coarsely crenulated throughout, *unreflected* edge of the prothorax, the blunt and turned-back tip of the anterior angle, the widely truncated posterior angular process, the two triangular nodules on the anterior disc, the carinate-costate elytra in strong contrast to the low, level, intermediate intervals, the ridged epipleuræ, the more strongly widened prothorax, &c., &c. Two examples were sent, both probably female, judging by the comparative slightness of the femora. (The strong characters described above are a sufficient justification for publishing a description of the one sex, especially since its nearest ally, *C. crenulicollis*, shows little sexual differentiation).

APASIS BEPLEGENOIDES, n.sp. (Text-fig. 8).

Elongate-ovate, upper surface dark copper-bronze, very nitid; beneath darker; antennæ, palpi, and tarsi piceous-red, tibiæ and tarsi clothed beneath with light red hair.

Head somewhat triagonal and strongly protruding from thorax, labrum prominent and punctulate, epistomal ridge prominent, with front edge concave, sides oblique, forehead squarely depressed, limited in front and on sides by well marked sutures, and behind by indistinct horse-shoe impression, coarsely punctulate. Eyes small, oblique, coarsely faceted, with hollow impression behind the eyes, neck finely punctured; antennæ stout and long, in both sexes extending beyond the base of prothorax, longer in male, third joint about equal to fourth and fifth combined, eleventh longer than tenth and acuminate. *Prothorax* in ♀ as wide as long, in ♂ rather longer than wide, truncate at base and apex; convex, without lateral foliation, sides regularly rounded, widest at middle, at apex a little wider than head; anterior angles obtuse and unseen from above, posterior angles widely obtuse and only indicated by slight enlargement of border in that region; border very narrow throughout and a little raised; central channel well marked; disc with two large foveæ near base, two large foveate impressions towards the sides, and several large scattered setiferous punctures, the whole minutely punctured. *Scutellum* raised, triangular and punctulate. *Elytra* rather narrowly ovate in ♂, widely in ♀, shoulders obsolete; regularly striate-sulcate, with six striæ on the upper surface of each elytron and two more on the sides; intervals equal, slightly convex and apparently quite smooth except for a few small setæ near the base and sides, each bearing a long, thin, upright hair; epipleuræ quite smooth, abdomen smooth and shiny, prosternum a little transversely strigose; metasternum and femora with scattered hairs; intermediate

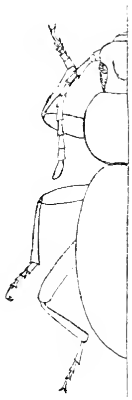

Fig. 8.

tibiæ curved, the others straight. *Dimensions*—♂. 18 × 6 mm.; ♀. 20 × 8 mm.

Hab.—Victorian Alps, at 5000 feet altitude.

Three specimens, one male, two female, were taken by the author (one under a stone of the cairn on the summit of Mount Blowhard, near St. Bernard Hospice). Three other specimens from Warburton, Victoria, have been given me by Mr. C. French. The Warburton specimens differ slightly from the Alpine in being smaller, more brilliantly metallic, and presenting some differences in the position and size of the prothoracic foveæ. The species can be readily distinguished from *A. Howittii* and *A. puncticeps* by colour, by its impunctate, more convex, distinctly channelled and constricted prothorax, and by its more strongly sulcate elytra. In general outline it strongly resembles *Beplegenes*, as also in the great distance of the eyes from the prothorax. The usual strong sexual differences in the tarsi, characteristic of the genus, are to be noticed.

Apasis Howittii Pasc.—I have been much puzzled by the great variations exhibited in what I take to be this species. Specimens taken by myself at Mount Macedon exactly correspond to Pascoe's rather meagre description, and to his figure (Ann. Mag Nat. Hist. Ser. 4, iii, p.140, pl xi.), and were, moreover, compared with the type. The two specimens*, both male, in the Macleay Museum, which were sent (so Mr. Masters informs me) by Dr. Howitt, from whom also Pascoe obtained his specimens, differ considerably from my own in being much smaller, more convex and coppery [*e.g.*, length 15 mm., while Pascoe gives 10 lines (*or 20 mm.*)]. I have lately taken a series of *Apasis* in the Victorian Alps (Mount Buffalo and St. Bernard) which present even greater differences. While hesitating to describe these as a new species, I would provisionally name the variety to distinguish it

var. *A. longicollis.*

Larger, flatter and more robust than *A. Howittii*, colour coal-black, shining, submentum strongly grooved longitudinally

* I have closely examined these, and find them identical with the species I have described above as *A. beplegenoides*. Dr. Howitt thus appears to have collected two species without noting their difference.

throughout (in *A. Howittii* only grooved anteriorly). *Prothorax* longer than broad (6 × 5 mm.) and very slightly widened at middle (in *A. Howittii* the length and breadth are about equal, and the sides distinctly rounded; in *A. puncticeps* Lea, they are still more widely rounded). Intermediate tibiæ curved (in *A. Howittii* straight). *Dimensions*—♂.21 × 6½ mm.; ♀.21½ × 7½ mm.

Hab.—Victorian Alps.

The sexual differences in the tarsi are strongly marked.

ADELIUM FOVEATUM, n.sp.

Oval, light bronze, prothorax slightly, elytra more, nitid, beneath glossy black, antennæ and palpi piceous, tarsi reddish on their upper surface, clothed below with grey tomentum.

Head: labrum strongly emarginate and punctulate, clothed with greyish hair, apex truncate and base widened; maxillary palpi unusually long, epistoma strongly punctulate, separated from front by curved depression, front rugosely punctulate; antennæ about extending to the base of prothorax, third joint distinctly shorter than the fourth and fifth combined, each succeeding joint slightly wider than the preceding, eleventh much the longest, ovoid with rather pointed apex. *Prothorax* wider than long (2·5 × 4 mm.), circularly emarginate at apex, nearly truncate at base, sides evenly and rather widely rounded, scarcely sinuate near base, and narrowly bordered throughout; anterior angles obtuse and rounded, posterior angles distinct and obtuse; subfoliaceous margin wide and flat towards base, a little convex anteriorly, separating sulcus variable but always indistinct, in general indicated by an elongate fovea. Disc slightly convex, general surface unevenly rugose but thickly punctulate with punctures of the same size as those on the head. A few larger punctures irregularly scattered on disc, more thickly on the margins. *Scutellum* curvilinear triangular, distinctly punctulate. *Elytra* oval, rather narrowly pointed apically, sides not at all widening behind the base, wider than prothorax at base, shoulders rounded, and emphasised by slightly reflexed epipleural border; disc rather flat, each elytron with seven lines of fine punctures;

between the first and second, third and fourth, fifth and sixth are regular rows of about six large foveæ, themselves contained in larger depressions, giving a wavy appearance to the surface. The rounded sides and epipleuræ coarsely punctulate. *Abdomen* with large foveate impressions near the sides. *Prosternum* sharply carinate; intercoxal process semicircular, entire and not produced backwards. *Dimensions*—10 × 4·5 mm.

Hab.—Mount Horror, Tasmania (Mr. A. M. Lea).

Four specimens are under examination, kindly sent me by Mr. A. M. Lea, the well known entomologist of the Agricultural Department of Tasmania. While allied to *A. abbreviatum* Boisd., the differences are well marked but not easy to define. To facilitate identification the following table of comparison will be of assistance :—

A. foveatum.	*A. abbreviatum.*
Size smaller, 10 × 4·5 mm., narrower and less convex.	*Size* larger, 11 × 5·5 mm., wider and more convex.
Colour less nitid, especially on prothorax, lighter bronze.	*Colour* more nitid, darker bronze.
Pronotum very uneven and rugose, subfoliaceous margins more distinct.	*Pronotum* shining and scarcely rugose, margins less distinct.
Elytra: general surface wavy, large foveæ at regular intervals.	*Elytra* : general surface smooth, large foveæ irregularly placed.
Prosternum strongly carinate. Tomentose clothing of tarsi grey. Posterior intercoxal process semicircular, not produced backwards.	*Prosternum* not carinate. Tomentose clothing of tarsi red. Intercoxal process nearly truncate in front, with carinate edge produced backwards.

I have not been able to detect any sexual differences in the specimens.

Adelium cuprescens, n.sp.

Compact, widely ovate, convex, a brilliant shining copper; antennæ, palpi, knees and tarsi piceous-red; beneath black and very nitid.

Head: labrum prominent and punctate, clypeus raised, straight, and, with the front, coarsely punctulate, continued backwards by a strongly raised ridge at right angles to clypeus extending to the inside of the eye; front thus squarely depressed, eyes large and prominent; antennæ extending beyond the base of prothorax, third joint at least equal to fourth and fifth combined, joints 4-10 obconic, gradually thickening towards apex and tending to become more ovate; eleventh elongate-ovate, longer and wider than tenth; mentum and submentum with large round punctures. *Prothorax* transverse (3 × 4·5 mm.), convex, without lateral foliation, apex rather circular, anterior angles emarginate, acute (about 80°) and a little recurved at the tips, sides sinuate, in front slightly, abruptly near base, widely rounded to greatest width behind the middle, posterior angles distinct and rectangular. Border at base, sides, and apex narrow, of equal width, recurved only at sides. Disc without central line, finely and regularly punctulate, with a few larger setiferous punctures irregularly scattered on surface. *Scutellum* small, transverse, and coarsely punctulate. *Elytra* rather squarely ovate, distinctly wider than prothorax, convex and widely rounded at apex, shoulders moderate; coarsely punctate-striate, each elytron with ten rows of large, round, evenly and closely placed foveate punctures placed in striæ, of which two rows are on the sides; punctures on outside row much larger than the rest and wider apart (4 on outside row occupy the space of 6 in adjacent row). The intervals strongly convex and closely punctured; epipleuræ coarsely punctulate, prosternum and abdomen very minutely punctured. Front tibiæ straight, intermediate and hind tibiæ rather strongly bowed, and compressed near apex. Intercoxal process semicircular, with raised margin. *Dimensions*—12 × 5·6 mm.

Hab.—Bardoc, West Australia.

A single specimen (♂?) has been kindly given me by Mr. C. French. The structure of the antennæ, in combination with the sulcate-punctate elytra, would place this species near *A. violaceum* Cart., Sect. ii.A. in my classification. It is quite distinct from all species known to me, nor can it be confounded with either of the three species described by Herr Gebien (Die Fauna Süd-west Australiens. Hamburg, 1905). The combination of foveate-like punctures in elytral striæ, with pronounced raised intervals is very unusual, which with its short broad form and brilliant metallic colouring should render its identification easy.

ADELIUM GOUDIEI, n.sp. (Text-fig. 9).

Elongate-ovate, copper-bronze, nitid, antennæ, palpi, legs and tarsi reddish.

Head: labrum prominent and truncate, epistoma very convex, oblique and raised at the sides, limited behind by a thin but definite straight suture, this meeting the more strongly indented ocular sutures at right angles, the latter obliquely continued and branched to meet the sides of epistoma; at the junction of clypeal and ocular sutures a seta bearing a long white hair; head rather finely and distantly punctured, punctures becoming finer and scarcer towards the vertex, closely but strongly rugose at base. *Prothorax* convex, wider than long (4 × 5 mm.), widest at middle, slightly emarginate, anterior angles rectangular, sides widely rounded, slightly sinuate anteriorly, strongly so posteriorly, hind angles a little dentate and rectangular, base and apex lightly bordered, sides with thickened upturned border, narrowly furrowed, or subfoliate, with a shallow elongate depression at sides of discal portion. Disc minutely and rather closely punctured, with about five large foveate punctures irregularly placed. *Scutellum* transversely triangular. *Elytra* a little wider than prothorax, regularly ovate, convex, shoulders rather squarely rounded, with upturned margin, evident from above at shoulders and apex. Seriate-punctate, with nine rows of punctures, in general very small (like pin-pricks) and irregularly spaced, with a few punctures of larger size. Intervals in general flat and

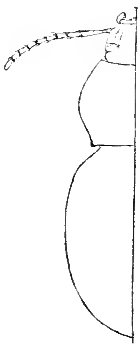

Fig. 9.

minutely punctulate, the fifth interval feebly raised. Suture depressed throughout and triangularly so behind scutellum. Epipleuræ minutely, two apical segments of abdomen more distinctly and closely punctulate. Intercoxal process truncate and split in front. Under surface generally smooth and metallic. Intermediate tibiæ bowed, others straight. *Dimensions*—14 x 6 mm.

Hab.—Sea Lake, North-West Victoria.

Three specimens, male, with strongly transverse front tarsi, have been sent me by that enthusiastic collector, Mr. J. C. Goudie, after whom I have named it. A typical member of my Sect.i.A., and closely allied to *A. Lindense* Blackb., it is sufficiently differentiated by its combination of lustrous bronze colour (as *A. ellipticum* Blackb.), with dentate rectangular hind angles to prothorax (as *A. Hackeri* Cart.), and nearly smooth pronotum (as *A. auratum* Pasc.).

ADELIUM SLOANEII, n.sp. (Text-fig. 10).

Elongate-ovate, shining metallic bronze above, antennæ, palpi and tarsi concolorous, bronze-black beneath, highly polished.

Head: labrum prominent and punctulate, epistoma subtruncate, nearly flat, clearly defined behind by semicircular suture, and together with the forehead coarsely and irregularly punctured; part behind the eyes only minutely so. Antennal orbits punctured like the forehead, separated from it by deep suture, and bearing on it a long distinct foveate impression. Eyes large and projecting; antennæ extending beyond the base of prothorax, stout, third joint less than fourth and fifth combined, joints 7-10 obconic and wider than preceding, eleventh ovoid-acuminate. *Prothorax* convex, transverse (2·5 x 4 mm.), widest behind the middle, base slightly wider than apex, apex subtruncate (seen from above), anterior angles scarcely advanced and obtuse, sides widely rounded, abruptly sinuate towards base, posterior angles prominent and rectangular; base truncate; the whole narrowly bordered with smooth upturned

Fig. 10.

margin. Disc coarsely, irregularly punctured, the punctures sometimes coalescing, sometimes separated by smooth shining spaces irregularly shaped and placed; with one or two larger punctures near the antero-central portion of each lobe, and shallow elongate depressions towards the sides; central line faintly (or not at all) indicated by slight depression, without any lateral foliation. *Scutellum* raised, triangular, and punctulate. *Elytra* wider than prothorax at base, shoulders widely rounded, sides subparallel on basal half, then gently rounded to apex; punctate-striate, with ten rows of striæ on each elytron, the punctures in striæ large, close, and regular (much larger than in *A. calosomoides* Kirby), largest and most exposed on two outside striæ; intervals regular, uninterrupted, convex (the strial punctures giving a somewhat crenulate aspect), and minutely punctulate; the third, fifth, seventh and ninth becoming wider and more costiform than the others towards apex, and *sometimes* slightly pustulose (in one specimen rather distinctly so) in this region. Epipleuræ with shallow irregularities of surface, scarcely punctulate; underside of femora and apical segment of abdomen finely punctured; tibiæ closely and more strongly punctured; tarsi and narrow line on tibiæ clothed with pale straw-coloured tomentum. Tibiæ enlarged near apex, anterior and intermediate tibiæ slightly bowed. Intercoxal process margined and narrowly rounded. *Dimensions*—11 × 4·6 mm.

Hab.—Blayney and Orange, N.S.W.

Three specimens are before me, all, I think, male, two collected at Blayney by Mr. T. G. Sloane, after whom I name it; the third has been for some time unique in my cabinet, labelled "Orange" in the handwriting of the late Dr. C. D. Clark. This species is evidently a member of my Sect. ii., Subsect. C., but is separated from all except *A. pestiferum* mihi, by its pronounced hind angles to prothorax. In only one specimen is the tendency to pustulation of elytral intervals at apex well marked. These characters, together with its metallic (not violet) colour, its subcrenulate intervals, and its raised alternate intervals should render it easy to distinguish.

SEIROTRANA BIMETALLICA, n.sp.

Elongate-ovate, very convex. Head and prothorax shining coppery-bronze, elytra metallic dark green bronze moderately shining, underside and legs dark bronze, shining; antennæ, oral organs and tarsi piceous; basal half metallic, apical dull.

Head: labrum emarginate, narrow and concave towards apex, epistoma prominent, rounded at sides and, together with the front, rugosely punctate, limited behind by well marked furrow, deepest at sides. Forehead flat and terminated hindward by a semicircular ridge behind the eyes, the latter prominent. Antennæ stout, not extending to base of prothorax; third joint little longer than fourth, apical joints slightly larger than the rest, eleventh ovoid. *Prothorax* convex, apex slightly bisinuate, with a feebly indicated depression at the middle, anterior angles a little advanced, rounded and (not widely) obtuse; sides moderately rounded, widest about half-way, then slightly sinuately incurved to the obtuse but distinct posterior angles; base curvilinear bilineal (seen from above), scarcely coarctate, with scutellum distinctly in front of hind angles, closely fitting the elytra; sides entire, and, together with apex, narrowly bordered (apex very narrowly so) with a darker colour, this border disappearing at base. Disc without lateral foliation, central line feebly indicated near base and apex; strongly and closely punctulate, the punctures near centre and apex tending to coalesce and form longitudinal rugosity, but distinct and round towards the sides, with four large shallow depressions in a transverse line across the centre, about equidistant from each other and the sides, the two inner more distinct. *Scutellum* transversely elliptic and punctulate. *Elytra* very convex, wider than prothorax, shoulders obtusely rounded but distinct, with narrow shining border only evident from above near shoulders and apex. Striate-punctate, with ten striæ in pairs on each elytron, the last pair on the sides, the tenth stria, at side, containing larger punctures, these becoming obsolete towards apex, where the margins become horizontal; between the second and third, fourth and fifth, sixth and seventh, eighth and ninth are wide raised convex intervals broken up into nodules on apical declivity, thes intervals bearing one or two punctures on each irregularly placed; sutural interval flat and depressed on disc, raised at apex; the whole surface closely minutely punctulate. Submentum, sides of sternum and epipleuræ bearing large round punctures, abdomen longitudinally strigose, distinctly punctured only on two apical segments. Legs short, all tibiæ curved, tarsi and apex of tibiæ clothed with dark golden pile. *Dimensions*—14 x 6 mm.

Hab.—Gingkin, near Oberon, N.S.W.

One specimen (♂) of this fine insect was captured by my son, R. B. Carter, in January, 1909. Though belonging to Group ii., of my classification, (These Proceedings, Vol. xxxiii., Part 2, p.398) it stands by itself in its striking bicoloration, and the smooth, subcostate elytral intervals.

Brycopia Cheesmani, n.sp.

Oval, violet-brown, shining. Antennæ, palpi, and tarsi pale red.

Head: labrum prominent, epistoma truncate with rounded angles, coarsely punctulate and very nitid, front rather concave, more distantly punctulate than epistoma and sharply separated from it by transverse and lateral sutures. Antennæ short, scarcely reaching base of prothorax, joints successively larger to apex, third joint longer and thinner than fourth, joints 4-10 bead-like, apical joint the largest and ovoid. Eyes large, round and not very prominent. *Prothorax* transverse, truncate in front and behind, widest at middle, anterior angles slightly advanced, obtuse; sides regularly rounded, and a little sinuate near the obtuse posterior angle. Sides and base narrowly bordered. Sides not explanate but a little emphasised near the middle by longitudinal foveæ. Disc regularly, shallowly punctulate (as on front). *Scutellum* raised, triangular and punctulate. *Elytra* widely ovate, moderately convex, wider than prothorax, shoulders rounded, sides tapering near apex; striate-punctate, each elytron with ten shallow striæ, punctures in striæ round and close. Intervals quite flat and finely punctured. Elytra prolonged forward in the scutellary region. Sternum and epipleuræ deeply and coarsely punctulate. Abdomen coppery and more finely punctulate. All tibiæ slightly bowed and attenuated. *Dimensions*—8 x 3·1 mm.

Hab.—Moruya, N.S.W. and Victorian Alps.

Two specimens sent by Mr. G. Cheesman, after whom I name this insect. In general appearance it is somewhat like a small *Adelium reductum* Pasc., but the elytral intervals are much flatter. A third specimen has since been taken by the author in the Victorian Alps.

BRYCOPIA FEMORATA, n.sp.

Elongate-elliptic, rather narrow, bronze above, black beneath, the whole very nitid; antennæ, palpi, labrum, knees and tibiæ red, tarsi pale red, apical parts of femora, except knees, pale yellow.

Head rather narrow, labrum emarginate and rounded at apex, epistoma distinct and round, limited by a furrow, concave (from front view), forehead grooved between the eyes, and, together with epistoma, finely punctulate, eyes large, not so prominent as in *B. tuberculifera* Champ., antennæ extending to the base of prothorax, slightly thickening outwardly, apical joint longest and a little wider than tenth, ovoid. *Prothorax* subquadrate, convex, a little broader than long, subtruncate at apex, bisinuate at base, sides a little rounded anteriorly, gently and evenly converging behind; greatest width near front angles, these obtusely rounded and deflected; hind angles subrectangular; disc finely and closely punctured, without any indication of central line, with a few setiferous impressions, of which two can be seen on margin at each side, two evenly placed a little in front of centre. *Scutellum* small and semicircular. *Elytra* wider than, and about two and one-quarter times as long as prothorax, narrowly elongate-oval, punctate-striate, with about ten rows of small, closely approximate punctures placed in fine striæ, the intervals flat, closely dotted with punctures distinctly smaller than those in striæ, and with about ten larger setiferous punctures promiscuously scattered thereon. (In the type-specimen there are six more regular than the rest, three each on the third interval.) Underside finely punctured. Femora swollen, with upper surface curved, front tibiæ curved, others straight. *Dimensions*—8 × 2·8 mm.

Hab.—Warburton District, Victoria.

I found this very distinct and interesting specimen (♂), alas! unique, amongst some heteromera kindly given me by that very enthusiastic entomologist, Mr. C. French, of the Victorian Department of Agriculture. It seems that *Brycopia* is likely to form as varied and numerous a genus as *Adelium* and *Seirotrana*; in this case presenting similar features in its femoral adornment to *S. geniculata* Haag-Rut., and *S. femoralis* Macl. It is otherwise allied, in form of prothorax and general shape, to *B. tuberculifera* Champ., from Tasmania, which is, however, a larger and more robust insect.

Table of *Brycopia*.

A. Sides of prothorax *not* or *very slightly* rounded.
- *b.* Elytra tuberculate .... *tuberculifera* Champ.
- *bb.* Elytra non-tuberculate.
  - *c.* Colour black.
    - Elytral intervals subconvex .... *longipes* Macl.
    - Elytral intervals smooth .... *dubia* Macl.
  - *cc.* Colour bronze.
    - Femora unicolorous pale red .... *minor* Cart.
    - Femora with apical half pale yellow .... *femorata* Cart.

AA. Sides of prothorax dictinctly rounded near middle.
- *d.* Prothorax crenulate at sides.
  - Surface pilose .... *pilosella* Pasc.
  - Surface non-pilose .... *crenaticollis* Cart.
- *dd.* Prothorax *not* crenulate at sides.
  - *e.* Colour black.
    - Elytral intervals subconvex (2-4 wider than rest).. *Taylori* Cart.
    - Elytral intervals sharply ridged .... *monilicornis* Macl.
  - *ee.* Colour bronze.
    - Prothorax canaliculate .... *parvula* Macl.
    - Prothorax not canaliculate.
      - Prothorax very convex, size 5·5 mm .... *globulosa* Cart.
      - Prothorax less convex, size 8 mm .... *Cheesmani* Cart.
  - *eee.* Bicolorous (elytra black, prothorax purplish).
    - Size smaller than above (4 mm.) .... *minuta* Lea.

THE GEOLOGY OF THE CANOBOLAS MOUNTAINS.

By C. A. Sussmilch, F.G.S., and H. I. Jensen, D.Sc.

(Plates vii.-ix.)

General Geology and Physiography.

i. Introduction.

The Canobolas, or Canoblas, are an isolated group of mountains, about seven miles to the south.east of the town of Orange, N.S.W., and lie at the junction of the three Counties of Bathurst, Wellington, and Ashburnham. Rising about 1600 feet above the level of the surrounding tableland, they form a conspicuous feature of the landscape, particularly when viewed from the west. Situated, as they are, so close to the main Western Railway line and in the neighbourhood of such a large town as Orange, it is surprising that they have received so little attention from geologists in the past.

In 1878, the late Mr. C. S. Wilkinson (then Government Geologist) visited the Canobolas, and came to the conclusion that the "Old Man Canobolas" had at one time formed a point of volcanic eruption on a somewhat grand scale.

In 1890, Prof. T. W. E. David visited the Old Man Canobolas, and subsequently contributed a brief note to the Proceedings of this Society,* in which he referred particularly to the occurrence of andesitic lavas on this mountain. In 1891, the Rev. J. M. Curran, in a paper read before the Royal Society of New South Wales,† described several rocks from this area, including porphyritic basalts from German's Hill, and fine-grained basalts from the Orange Racecourse. The German's Hill rocks were evidently andesites.

In December, 1901, one of us (C. A. Süssmilch) began a geological survey of the area in conjunction with the Rev. J. M. Curran. A considerable amount of field-work was then done, but the work was subsequently dropped. A re examination, some years later, of the material which had been collected, together with subsequent visits to the Canobolas by one of us (C.A.S.) showed that a resurvey was desirable. This has now been done, and although the rough geological map which resulted from the previous investigation forms the basis of the present survey, the field-work has been done practically *de novo.*

ii. Petrography.

The rocks of this area may be classified as follows :—

Tertiary.	1. Diatomaceous earth. 2. Tuffs. 3. Lavas—Comendites, Trachytes, Andesites, and Basalt.
Palæozoic.	4.(?)Carboniferous—Augite-Porphyrite (intrusive). 5. Devonian—Shales, Sandstones, Quartzites and Conglomerates. 6. Silurian—Slates, Limestones, Rhyolite, and Rhyolite Tuff. 7. Ordovician—Graptolite Slates.

Ordovician.—Graptolite slates occur over a small area near Cadia, a few miles to the south of the Canobolas. This area has not been included in the accompanying map.

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* Note on the "Occurrence of Andesitic Lavas at the Canoblas, near Orange." These Proceedings, Second Series, Vol. v., p.426, 1890.

† A Contribution to the Microscopic Structure of some Australian Rocks. Journ. Proc. Royal Soc. of New South Wales, Vol. xxv., pp.198-204, 1891.

Silurian and Devonian.—That portion of these formations which occurs immediately to the west of this area, has been already described by one of us.‡ In the immediate neighbourhood of Orange, numerous outcrops of slates occur, which are well shown in the cuttings along the Forbes-Molong Railway line. No fossils have been found in these slates, but they are probably of Silurian age. A small outcrop of Silurian limestone occurs on the Canomodine Creek, in the south-western part of the area. All the Palæozoic strata have been subjected to considerable folding, and have been subsequently much denuded. As some of the fossils from this district had not been determined and described when the description of the formations in which they occur was printed, and the names of some have been altered, a corrected list is here included.

List of Silurian Fossils from the Canobolas District.

ACTINOZOA.

- *Halysites lithostrotonoides.*
- *australis.*
- *pycnoblastoides.*
- *Süssmilchii.*
- *cratus.*
- *peristephesicus.*
- *Mucophyllum crateroides.*
- *Arachnophyllum epistomoides.*
- *Mictocystis endophylloides.*
- *Tryplasma liliiformis.*
- *columnaris.*
- *princeps.*
- *Favosites gothlandica.*
- *Heliolites.*
- *Cyathophyllum.*
- *Claudopora* sp.ind.
- *Pachypora* sp.ind.
- *Zaphrentis* sp.ind.

‡ Süssmilch, C. A., F.G.S., Note on the Silurian and Devonian Rocks occurring to the west of the Canobolas Mountains, near Orange. N. S.W. Journ. Proc. Royal Soc. of New South Wales, xl., p.130, 1906 [1907].

SPONGIDA.	*Astylospongia.*
TRILOBITA.	*Bronteus* sp.ind.
	Phacops sp.ind.
BRACHIOPODA.	*Conchidium* (*Pentamerus*) *Knightii* var. *stricta.*
	,, ,, *Etheridgii.*
	Anoplotheca(?) *australis.*
	Camarotœchia(?) *Süssmilchii.*
	Conocardium Davidis.
	Orthisina(?).
CRINOIDEA.	Crinoid stems.

Carboniferous(?).—Extensive intrusions of augite-porphyrite (diabase-porphyry) occur, intruding the Silurian slates in the northern part of the area. These are well exposed along the Forbes Road, and in the cuttings of the Forbes-Molong Railway line. These intrusions possibly took place during the Carboniferous Period.

Tertiary.—(A) Volcanic. These are classified as follows:—

(*a*) Leucocratic Trachytes including Comendites, Pantellarites, light-coloured Arfvedsonite-Trachytes, etc., with their corresponding dyke-rocks. They are all typically light-coloured, and more or less acidic in composition.

(*b*) Melanocratic Trachytes, including Phonolitic Trachytes, Trachy-Andesites, with their corresponding dyke-rocks and tuffs. These are typically darker in colour than the previous group, and some of them might easily be mistaken for andesites in the hand-specimens.

(*c*) Andesites, mostly porphyritic, and inclined to basic in composition.

(*d*) Olivine-Basalts.

(B) *Diatomaceous Earth.*—One deposit was observed in the Parish of Bowan, near the Cargo Road. The mode of occurrence was somewhat obscure, but it appeared to lie below, and therefore to be older than the Andesites.

The Diatoms belong largely to the genus *Melosira*, while sponge-spicules (*Spongilla*) are also abundant.

iii. Physiography and Topography.

These mountains are situated on that portion of the western tableland which forms the divide between the watersheds of the Lachlan and Macquarie Rivers. The tableland has a general altitude of about 3000 feet, and is a continuation of one of the Blue Mountain peneplains described by Mr. E. C. Andrews.* In his first description he refers to it as the Lithgow Plain, but subsequently called it the Blue Mountain Plain.† The earlier name is too local for such an extensive physiographical feature, and, in our opinion, it would be preferable to call it the Orange-Blue Mountain Plain. Between the Canobolas and the Blue Mountains numerous residuals of an older peneplain occur in the form of long ridges and isolated hills. These appear to reach a general altitude of about 3600 feet, and would correspond to the second level in the Blue Mountains referred to by Mr. Andrews, and which he called the Blue Mountain Plain. As this name has now been taken for the lower level (3000 feet level), we would suggest the name of the Clarence Plain for this level.

Standing on top of the Canobolas and looking eastward, one can see several isolated and apparently flat-topped residuals of a still higher level, which appear to exceed 4000 feet in altitude. These probably belong to Mr. Andrews' Jenolan Plain.

The 3000 feet tableland (Orange-Blue Mountain Plain), which in this district has been cut out of the folded Silurian and Devonian strata, is intersected in all directions by numerous shallow, mature valleys, from 100 to 200 feet deep. The township of Orange lies in one of these mature valleys, and the valleys of the present cañon-cycle head into them.

The Canobolas Mountains proper cover an oval area, which has a maximum diameter of about 12 miles, and extends from the Orange-Forbes Railway line on the north, nearly to Cadia on the south; and from the Great Western Railway on the east, to the

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* Records Geol. Survey N. S. Wales, 1904, Vol. vii., Part 4.

† Andrews, B.E., B.A.—An Introduction to the Physical Geography of New South Wales. Published by W. Brooks & Co., Sydney. 1905.

Cargo Road on the west. The highest point is the Old Man Canobolas, which reaches an altitude of 4610 feet. The principal peaks are as follows :—

Old Man Canobolas	...	4610 feet.	
Towac (The Bald Knob)...		4500 ,,	
Young Man Canobolas	...	4400 ,,	
The Pinnacle ..	...	4050 ,,	
The Bald Hills (three)	...	4000 ,,	(about).
Johnston's Pinnacle	...	3850 ,,	
Watt's Pinnacle ...	...	3810 ,,	

The Bald Hills, Towac, and the Old Man Canobolas lie on a definite north and south line, while the other peaks stand more or less promiscuously to the east of this line.

To the west of this line the tableland is much lower. At Molong, for example, the altitude of the peneplain is only about 2000 feet. It is quite possible, therefore, that an important fault may occur here, separating the Orange portion of the uplifted peneplain from that part immediately to the west.

That portion of these mountains which reaches above the 3000 feet level, consists entirely of volcanic rocks, lavas and tuffs, piled up around several different volcanic vents. No distinct crater rings remain. We have, then, an approximately level platform of denuded Silurian and Devonian rocks, 3000 feet high, upon which has been piled a series of lavas and tuffs to a maximum height of 1600 feet above this level. These are, therefore, essentially mountains of accumulation. The earlier lavas (comendites, trachytes and andesites) have not been found below the 3000 feet level, but the later basalts have flowed into and, in some cases, filled the mature valleys on top of the tableland. In the mountains the streams are all consequent streams, flowing by direct courses to the tableland; and in most cases they have cut fairly deep gorges into the volcanic rocks. Those flowing to the north and east join the Macquarie River, those to the south and west eventually join the Lachlan.

iv. Descriptive Geology.

Most visitors to the Canobolas travel by the Cargo Road as far as German's Hill, and then turn off on to a branch road to the south, which leads to the top of the Old Man Canobolas. From a tourist's point of view this is an excellent trip, as, from the top of the Old Man can be seen one of the most extensive views in New South Wales. From a geologist's point of view, however, this is the least interesting road to take, as the rock-exposures are not particularly good, nor do we meet with many rock-types. A much more interesting route is that by the Towac Road. This road, soon after leaving Orange, crosses the Molong-Forbes Railway line near the Orange Racecourse, where some good examples of columnar basalt may be seen, both in the railway cuttings and in the adjacent municipal quarries. From here, onward for some miles, the road passes through some of the richest orchard and agricultural land in the district, the rich soils being derived from the decomposition of the andesite lavas. Passing the Canobolas Public School, the andesites give place to trachytes and comendites until the road reaches Summer or Molong Creek, where basalt again makes its appearance. The road now, after passing the Towac School (8 miles from Orange), plunges into a narrow gorge between The Pinnacle and Watt's Pinnacle, for half-a-mile, and then ends in a beautiful valley entirely encircled by hills, and known locally as the "Devil's Hole." We are now in the centre of the most interesting part of the Canobolas Mountains. Immediately to the west stand the Young and Old Man Canobolas; to the south-west are Towac Mountain and the Bald Hills; to the north, Johnston's and Watt's Pinnacles; and to the north-east stands The Pinnacle. This is the centre of the oldest and most acid lavas (comendites, etc.), and surrounding them, in a roughly concentric fashion, in the following order, are the more basic trachytes, with their associated tuffs, then the andesites, and finally the basalts.

1. The Lava-Flows and Tuffs.

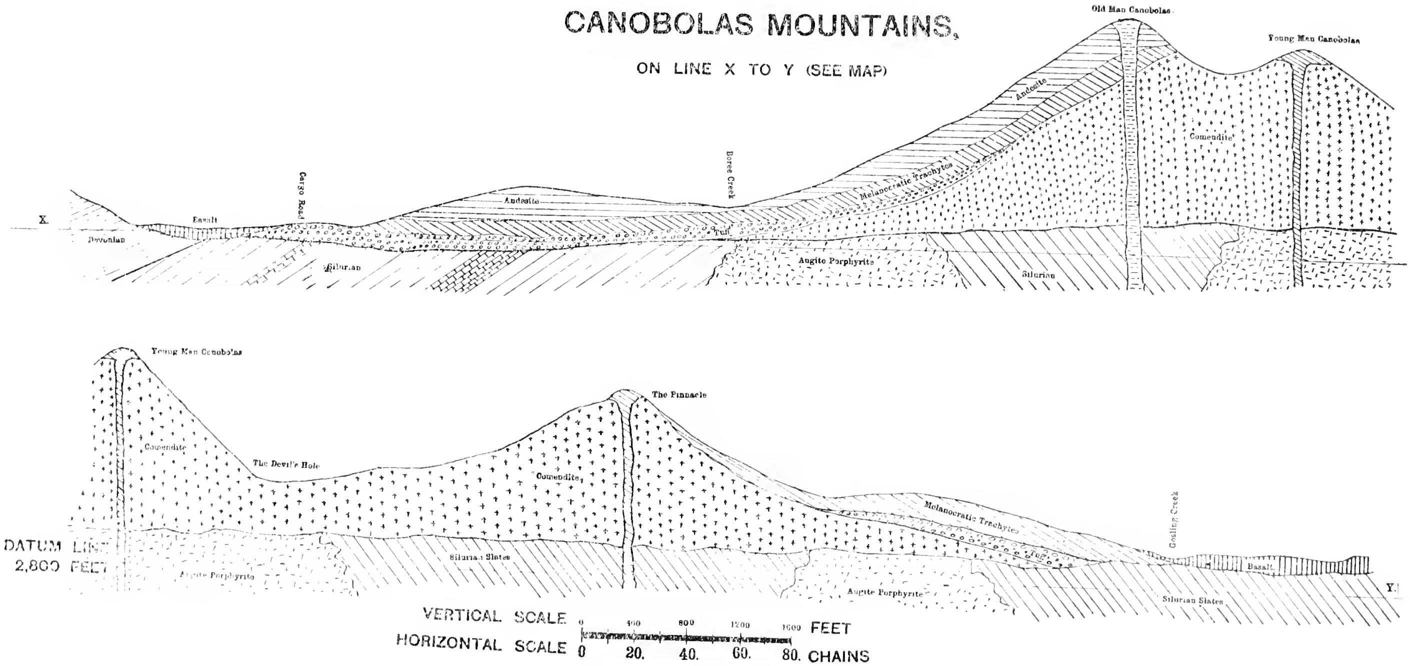
(*a*) *The Leucocratic Trachytes.*—These include comendites, pantellarites, and the lighter-coloured trachytes, all of which are typically white or light bluish-grey in colour, aphanitic in appearance (although glassy examples occur), and may be more or less porphyritic. They are extensively developed in the central area, particularly in and about the Devil's Hole valley, and about the head-waters of the Cadianjulong Creek. The most characteristic of these rocks is the *Orthophyric Arfvedsonite Comendite* (X.583) of which there are large exposures at the base of the Young Man Canobolas, and in the Bald Hills. The former hill, with the exception of the top, is built up almost entirely of this rock; so also are the Bald Hills, with the exception of cappings of the more basic trachytes upon two of them. The centre one of these three hills has a rounded summit, exposing a bare outcrop of this rock, devoid of soil and vegetation, which, with the white colour of the rock, gives it a striking appearance. This rock polishes well, taking on a beautiful honey-yellow colour mottled with dark blue, and makes a handsome ornamental stone. A second type of arfvedsonite-comendite (X.631) although not differing appreciably in composition, differs somewhat in appearance, and has a characteristic bluish-grey colour. This constitutes the bulk of the Pinnacle, and is well exposed all along the east side of the Devil's Hole. On Johnston's Pinnacle massive bold outcrops of light-coloured ægirine-trachyte occur, exhibiting columnar structure.

All of these leucocratic types of trachyte give bare rugged outcrops, and the soil derived from their decomposition, as one would expect from their composition, is very poor in character. Columnar structure is not uncommon. The mode of occurrence of these acid lavas suggests that they were erupted from a number of different vents. Owing to their acid composition they solidified rapidly, and censequently did not travel far, but built up steep lava-cones. These are the oldest of the Canobolas lavas, and, wherever junctions occur, are seen to be overlain by the more basic rocks (see figs.1 and 2).

(*b*) *The Melanocratic Trachytes.*—These differ from the leucocratic types in containing little or no quartz, a relatively large proportion of the ferromagnesian constituent, and are more

SECTION ACROSS THE CANOBOLAS MOUNTAINS,

ON LINE X TO Y (SEE MAP)



alkaline in composition. This gives these rocks a darker colour, some of them appearing andesitic or even basaltic in appearance in the hand-specimen. These characteristics make the mapping of the boundaries between this series and the more basic rocks somewhat uncertain; and, in many places, the boundaries given

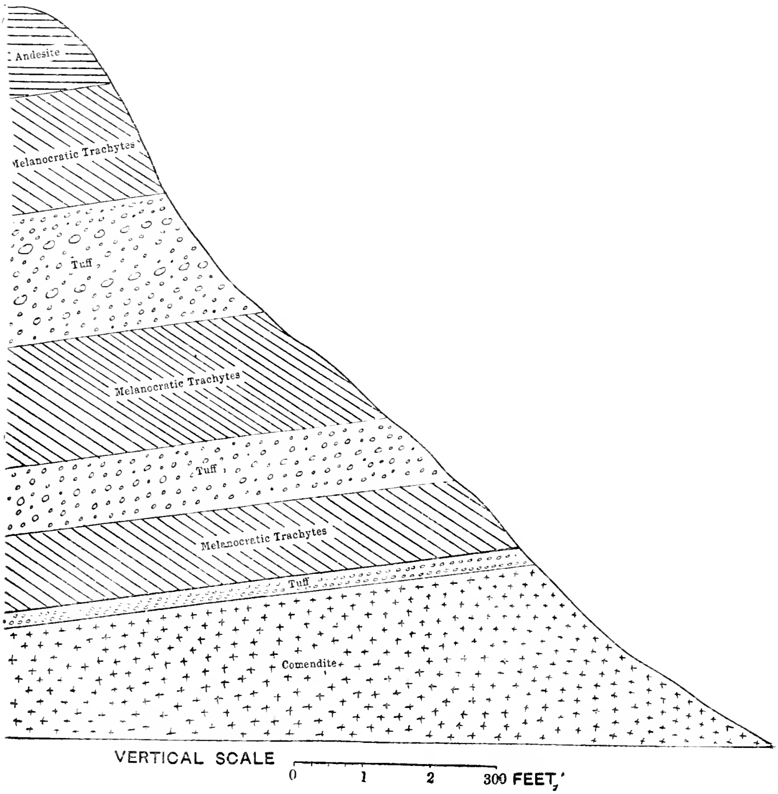


Fig. 1.—Diagrammatic Section from Towac Mountain to The Devil's Hole, showing succession of lavas and tuffs.

in the accompanying map are only approximate. The alkaline trachytes outcrop over a considerably larger area than do the more acid type. They are found capping the comendites of the

Young Man Canobolas, and two of the Bald Hills; they form the bulk of Watt's Pinnacle, and almost entirely encircle the central area of acidic rock. The distribution of these lavas, with their associated tuffs, indicates a central point of eruption, somewhere adjacent to what is now called the Devil's Hole. This valley itself has somewhat the appearance of a huge crater, but is probably a valley of denudation. The plugs of sölvsbergite which occur at the top of the Young Man Canobolas and on The Pinnacle, are the probable vents from which this series was erupted.

All the tuffs so far observed are associated with the melanocratic trachyte-lavas. The following section taken from the divide between the head-waters of Summer Creek and Cadianjulong Creek, immediately south from Plowman's Farm, shows three distinct beds of tuffs.

The lowest bed, which rests directly upon the comendite, is somewhat fine-grained, and contains numerous fragments of

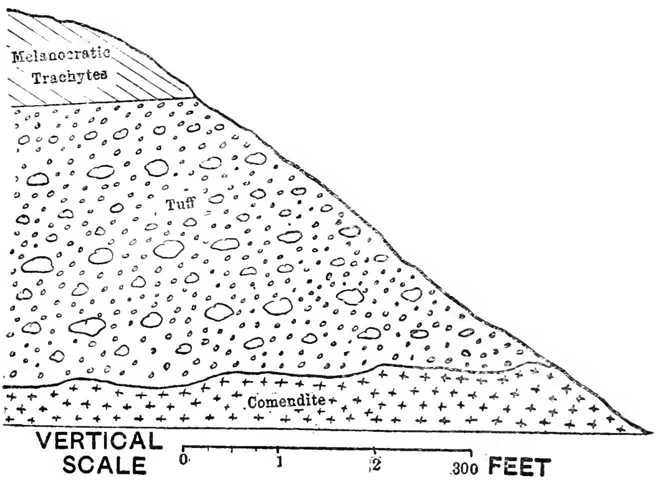


Fig. 2.—Section at Cadianjulong Creek, showing tuffs and lavas.

comendite. The upper beds are much coarser, and contain ejected blocks of all sizes. About 2 miles further south, on the Cadianjulong Creek, a tuff-bed, 340 feet thick, occurs, as shown in the accompanying sketch (fig. 2).

On the Pinnacle Road, about $1\frac{1}{4}$ miles from the summit of The Pinnacle, tuffs occur, containing ejected blocks ranging up to 1 ton, or even more, in weight. A somewhat similar outcrop occurs at Norris's Farm, on the western side of the Canobolas. All these tuffs are essentially trachytic in composition, but contain numerous fragments of the earlier and more acid comendites, etc. The tuff-beds, as far as could be observed, dip away from the central area. They also outcrop on the road leading to the top of the Old Man, but this, and several other small outcrops, have not been shown on the accompanying map. Mr. T. Harvey Johnston, B.Sc., informs us that he found fragments of coniferous wood in these tuffs near German's Hill.

(*c*) *The Andesites.*—These lavas are of a somewhat basic type, and contain numerous phenocrysts of plagioclase, with occasional phenocrysts of augite and olivine. They are sometimes vesicular. A reference to the map will show that they are extensively developed to the west and north of the area dealt with. The boundaries shown on the map are only approximate; firstly, because the area to the west and north-west was not surveyed in detail; and secondly, owing to the frequent difficulty in discriminating between the decomposed outcrops of the more basic trachytes and andesites respectively.

The Old Man Canobolas was the point of eruption from which these lavas were derived, Prof. David, in the note already referred to, gives the following description of the neck or plug on top of this mountain :—" At a point bearing S. 15° W., 78 yards distant from the Trigonometrical Station on top of the 'Old Man Canobla' is, what the author considers to be, the central 'neck' of the volcano, in the shape of a nearly circular mass of coarsely crystalline very dense andesitic lava, rising from four to five feet above the general level, and showing strongly marked oblique lamination, the laminæ dipping in towards the centre of the neck at an angle of from 40° to 60°. The neck is about $\frac{1}{2}$ chain in diameter, and is surrounded by beds of scoriaceous lava to the north and scoriæ to the south. The beds of the former to the north dip northerly at about 15°, and are overlaid by a dense flow of lava, on the highest point of which the Trigonometrical Station now stands. South of the neck the beds of scoriæ dip first northerly towards the neck, and then qua-qua-versally chiefly from west towards south at an angle of 20° up to 40°, as far as the western edge of the mountain, where the scoriæ pass into a coarse volcanic agglomerate composed chiefly of large pieces of cellular andesitic lava."

The writers of this paper were unfortunate on the day they visited the Old Man Canobolas, in meeting with dense mists and heavy rain, which made a detailed examination impossible. They saw enough, however, to satisfy themselves of the general correctness of Prof. David's views. One of the best outcrops of these andesites can be seen at the Hopetoun Waterfall, where one of the flows is over 100 feet thick; good outcrops also occur in the road-cuttings on the Towac Road, near the Canobolas Public School.

The decomposition of the andesites gives rise to excellent soils for agricultural and fruitgrowing purposes, as evidenced from some of the farms and orchards which occur on the andesite soils along the Towac Road.

(*d*) *The Basalts.*—These are typical compact olivine-basalts, and frequently exhibit columnar structure. An examination of the accompanying map will show that they completely encircle the Canobolas Mountains, and occur at and about the 3000 feet level. Nowhere do they occur on any of the high hills, the highest point to which we succeeded in tracing them being 3300 feet, on Summer Creek (Molong Creek). Their distribution and occurrence suggest that they were poured out from fissures in the sides of the mountains, flowed into and submerged many of the shallow mature valleys of the tableland, and spread out over the tableland-level, extending to many miles beyond the limits of the area mapped.

2. Dykes and Necks.

(*a*) *Dykes.*—These are not abundant. A biotite-trachyte dyke (X.613) outcrops on the saddle between the Old and Young Man

Canobolas; another, consisting of quartz-acmite-trachyte-porphyry (X.691) occurs on Portion 259, Parish of Waldegrave. Lastly, what appears to be a large dyke occurs on the main divide south of the Devil's Hole, and consists of an oligoclase-sölvsbergite (X.688); this outcrops again further to the east on Portion 171, Parish of Waldegrave.

(*b*) *Necks.*—Plugs of sölvsbergite, coarsely porphyritic, occur on top of the Young Man Canobolas (X.686) and near the top of The Pinnacle (X.691). These two plugs, as already mentioned, probably represent the vents from which most of the melanocratic types of trachyte were erupted. The only other plug observed is that already described as occurring on top of the Old Man Canobolas, from which the andesites were erupted.

3 Order of Eruption.

The order of eruption, judging from the field-evidence, was from acidic to basic, as follows :—

1. Comendites, pantellarites, and quartz-trachytes.
2. Trachytes, and phonolitic-trachytes, with abundant tuffs.
3. Andesite, somewhat basic in composition.
4. Olivine melilite basalts.

No great interval of time seems to have elapsed between the eruptions of 1 and 2, and between 2 and 3. But between the eruptions of 3 and 4, a long period of erosion is indicated, showing a long lapse of time after the eruption of the andesite, before the basalts were poured out.

The volcanic history of the district was probably as follows:—

Silurian—submarine eruptions, with the production of acid rhyolites and rhyolite-tuffs.

Devonian—none.

Carboniferous—intrusion of intermediate augite-porphyrites.

Mesozoic—none.

Eocene / *Miocene* }—outpouring of comendites, trachytes and andesites.

Pliocene—fissure-eruptions, with outpouring of basic melilite-basalts.

4. Age of the Volcanic Rocks.

No direct evidence has yet been found as to the age of the alkaline lavas of this district. The oldest fossiliferous strata observed are of Devonian age, and these had been extensively folded and denuded before the lavas were deposited upon them.

The age of the peneplain upon which they rest is also uncertain. Mr. E. C. Andrews, in his published description of this feature in the Blue Mountains, considered that it had been cut out in the Pliocene period, but has since expressed the opinion that it may be considerably older. Until the study of the peneplains of Eastern Australia is carried into the marine Tertiary areas of Victoria, it will be difficult to arrive at any satisfactory conclusion. As already pointed out by one of us (H. I. Jensen),* a remarkable similarity occurs in every way between the alkaline rocks of the Canobolas area, and those of the Warrumbungle and Nandewar areas. In all these areas, also, the lavas have been deposited on top of what are, probably, portions of the same peneplain. There is every reason for believing, therefore, that the eruptions in the three areas were contemporaneous. In the Warrumbungle Mountains, fossil leaves have been obtained from a bed of tuff, near the base of the volcanic series. These have been described by Mr. Henry Deane,† who considers that they may be of Eocene age. This determination, if correct, would relegate the beginning of the volcanic series to the Eocene, and would correspondingly put back the cutting out of the peneplain to the early Eocene, or even Cretaceous. It is questionable as to how much reliance can be placed upon the evidence of a few Tertiary leaves, as to geological age; so that the age, both of the peneplain, and of the volcanic series, must still remain doubtful, but we can assume that it still lies somewhere between the Upper Cretaceous and the Miocene.

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* The Alkaline Petrographical Province of Eastern Australia. Proc. Linn. Soc. N. S. Wales, 1908, p.589.

†Notes on Specimens of Fossil Leaves from the Warrumbungle Mountains. Rec. Geol. Surv. N. S. Wales, Vol. viii., Part 3.

Petrological Descriptions.

The petrology of the Silurian and Devonian rocks to the west of the Canobolas, has already been described by one of us (C. A. Süssmilch,* F.G.S.). The rocks probably underlie the later volcanic series of the Canobolas, but, as they do not outcrop on the surface in the area now under special consideration, no further mention of them will be made here.

The volcanic series is divisible into :—

A. *Leucocratic Trachytes* (including comendites, pantellarites, light-coloured arfvedsonite-trachytes, etc.) and the dyke-rocks corresponding to them.

B. *Melanocratic Trachytes* (including phonolitic trachytes and trachy-andesites), and the corresponding dyke-rocks.

C. *Andesites*, chiefly of an alkaline facies.

D. *Basalts* (with melilite and analcite.)

With the exception of some of the basalts, all the rocks of this volcanic series belong to the alkaline division.

The plan will here be followed of describing a few of the typical rocks of each group in some detail, and appending brief petrological sketches of other varieties belonging to each group.

Volcanic Sequence.—The earliest eruptions gave rise to flows, plugs, necks, and dykes of leucocratic trachyte.

The next eruptions yielded melanocratic trachytes and trachy-andesites, and intrusions of their dyke-equivalents took place. Pyroclastic rocks of this period are common.

The following eruptions gave rise to alkaline andesites, and the basalts were extruded last. The sequence is therefore one of increasing basicity.

It is also a matter of interest that the earliest eruptions were of a very explosive nature, whereas the late eruptions poured out immense quantities of lava in a quiet and peaceful manner.

A. *The Leucocratic Trachytes.*—No.X.608. Field-name, Quartz-Trachyte. Loc.: Cadiangelong Creek.

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* Journ. Proc. Roy. Soc. N. S. Wales, Vol. xl., p.130.

Handspecimen: yellowish-grey rock in which small sanidine phenocrysts can be recognised with the naked eye.

Microscopic Structure—(1) Texture: hypocrystalline, hiatal porphyritic, with trachytic fabric in the fine-grained base. (2) Composition: felspar, the dominant constituent, forms over 80 % of the slide. It is always idiomorphic, and occurs chiefly as Carlsbad twins. The crystals have an orthorhombic aspect, and have the faces *m*(110), *b*(010), *c*(001) and *x*(101) well developed. Consequently the sections obtained are mostly equant (square, five-sided and six-sided), and some rectangular, elongated in the *c*' direction, or more irregular when cut obliquely. Some crystals twinned on the Baveno-law, and apparently enclosed by the faces *c*(001), *y*(201), *z*(130), and *b*(010) are also present. Manebach twinning, with *c* as composition-face, has also been detected. In addition, other complex forms of twinning occur, some approaching the albite-, others the pericline-type, but they show as shadowy bars instead of distinct lamellæ. Twinning of this kind is probable due to an interlamellation of two varieties of felspar. The extinction-angle measured on the edge *cb* is from 6° to 12° in different crystals. Inclusions consisting of sagenitic rutile, blue amphibole and brown amphibole, occur in the felspar. Cross-cracks parallel to (100) are well developed. From the observed characters it is clear that the felspar has the composition of soda-sanidine, which sometimes becomes microcline-microperthite by the development of complex twinning. The next mineral in order of abundance consists of irregular grains of a deep reddish-brown mineral, pleochroic from wine-red to almost black-opaque. The pleochroism is to some extent masked by high absorption. Cleavage is faint. This mineral tends to form a pœcilitic intergrowth with felspar, and the blue soda-amphibole clusters round it, the brown mineral merging into the blue by imperceptible gradations. The blue hornblende appears to be riebeckite, and the brown is probably kataphorite. The two together form 7-8 % of the area of the slide. Glass and other isotropic materials (including isotropic chalcedony and opal) form about 10 % of the area. A few allotriomorphic quartz-grains occur, and also some grains of a yellow isotropic mineral with high refractive index, which tend to gather round the brown amphibole. This yellow mineral is probably perofskite.

3. Order of consolidation.

Rutile ————
Kataphorite and
Cossyrite(?)—————————
Riebeckite ————————————————
Perofskite(?) ———————
Anorthoclase ———————
(1st generation)
Do.(later generations) ——————————
Quartz ————
Glass ————

4. Name : Trachytic Kataphorite-Riebeckite-Comendite.

5. Magmatic name: Kallerudose (see Analysis vi., p.191). This magma is common in the Glass House Mountains.

No.X.583. Quartz-Trachyte. Loc.: Canobolas.

Microscopic Texture : fine-grained, holocrystalline, with an hypidiomorphic granular fabric approaching *orthophyric.*

Constituents : felspar, arfvedsonite, ægirine-augite, quartz, and eudialyte(?). The felspar consists of corroded, anorthoclase phenocrysts exhibiting shadowy extinction, and fine sanidine microlites with an extinction of 8°-10°. Some are nephilinitoid, and some prismatic in habit. The amphibole consists of mossy poikilitic aggregates, which exhibit the pleochroism of arfvedsonite (viz., $\mathfrak{c}$ deep blue-black, $\mathfrak{b}$ lavender, $\mathfrak{a}$ pale greenish-yellow), and of ragged grains which approach riebeckite closely in colour and pleochroism, but have a higher extinction-angle (about 10°). The absorption of the typical poikilitic arfvedsonite is $\mathfrak{c}>\mathfrak{b}>\mathfrak{a}$, and the extinction ($\mathfrak{a}$: c') = 14°. Skeleton crystals of brown pleochroic cossyrite occur sparingly. Very minute ægirine-augite grains and rods are abundant interstitially. A yellow, feebly pleochroic mineral occurs; it changes from yellow to a faint peach-blossom tint on rotating the stage, and is resolved between crossed nicols into zones, some of which are isotropic, others doubly refracting.

It frequently forms the nucleus of an amphibole group. Possibly it is eudialyte. Quartz is an abundant interstitial constituent in allotriomorphic grains.

Order of consolidation :

1. Eudialyte(?) ——
2. Arfvedsonite ————
3. Felspar ——————
4. Ægirine-Augite ———
5. Quartz ——

Name : Orthophyric Arfvedsonite-Comendite.

Magmatic name ; Kallerudose (Analysis vii., p. 191).

No. X. 625. Soda-Trachyte. Loc.: Portion 92, Parish Towac.

Handspecimen : bluish-grey compact rock.

Texture : hypocrystalline with trachytic fabric.

Composition : the phenocrysts consist of soda-sanidine. The base consists essentially of felspar microlites. In addition, the rock contains small amounts of ægirite, wöhlerite, riebeckite, magnetite, primary hæmatite, and isotropic residuum. A little secondary hæmatite and magnetite are also present.

Name : Wöhlerite-bearing Soda-Trachyte.

No. X. 635. Soda-Trachyte. Loc.: Portion 92, Parish Towac.

Microscopic Texture : porphyritic, hiatal, perpatic. Hyalopilitic to trachytic base, which varies in grain-size, from cryptocrystalline (or hypocrystalline) to microcrystalline.

Composition : felspar is the main constituent. Magnetite, laavenite and glass are present in minor amount. The felspar phenocrysts are composed of cryptoperthite. That of the base consists of sanidine laths. In many parts of the base we get minute needles of laavenite(?), with nearly straight extinction, and parting parallel to the prism-zone. They are optically negative, and have the pleochroism $\mathfrak{a}$=light wine-yellow, $\mathfrak{b}$= greenish-yellow, $\mathfrak{c}$=brownish-yellow, and absorption $\mathfrak{c}>\mathfrak{b}>\mathfrak{a}$. The magnetite is rounded by corrosion. The glass is interstitial. Nepheline is suspected in the base.

Name : Hypocrystalline, Laavenite-bearing Soda-Trachyte.

Note: this specimen and the preceding, X.625, are clastic fragments out of the tuff-beds.

No.X.638. Vesicular, bluish-grey Trachyte. Loc.: Forbes Road, near Molong Road.

This rock varies in grain-size from cryptocrystalline to microcrystalline, and has pilotaxitic fabric. Its components are felspar, ægirine, arfvedsonite, and laavenite(!).

No.X.631. Compact, bluish-grey Trachyte. Loc.: east side of Plowman's Farm.

Texture: holocrystalline, porphyritic, perpatic, with very fine even-grained trachytic base.

Composition: the dominant constituent is felspar. As minor, yet essential, constituents, there are quartz, arfvedsonite, and barkevicite. The felspar phenocrysts consist of cryptoperthitic anorthoclase of prismatic habit. The felspar of the base consists of lath-shaped microlites of sanidine (soda-rich?). The amphibole in poikilitic aggregates is pleochroic in brownish-yellow, greenish-blue, and blue-black. The brownish tints come mainly from the edge of each grain, and appear to be due to a rim of barkevicite surrounding each arfvedsonite grain. Secondary leucoxene and quartz are present.

Name: Trachytic Arfvedsonite-Comendite.

No.X.630. Soda-Trachyte. Loc.: north side of Young Man.

Handspecimen: compact, fine-grained, bluish rock, with a few phaneric crystals.

Texture: holocrystalline, with trachytic fabric in the fine even-grained base.

Constituents: (a) felspar of two generations, (b) quartz, (c) riebeckite, (d) wöhlerite. The phenocrysts consist of anorthoclase. They are of orthophyric habit, more or less corroded, and show shadowy extinction from ultramicroscopic twinning. They are optically negative and almost uniaxial; $\mathfrak{a}$ lies near the a axis. The felspar of the base consists of lath-shaped sanidine microlites with Carlsbad twinning. Quartz is a rather abundant constituent in the base; it is quite allotriomorphic, and often completely envelops felspar crystals in an ophitic manner The soda-amphibole occurs as mossy and feathery aggregates of grains, and in minnte rods. It has the characteristic properties of riebeckite. As an accessory we have needles of a yellow, highly birefringent but feebly pleochroic mineral, which appears to be wöhlerite.

Name: Riebeckite Wöhlerite(?) Comendite.

No.X.618. Compact whitish Trachyte. Loc.: south side of Johnston's Pinnacle.

This rock resembles the typical Conowrin trachyte of the Glass House Mountains.

Texture: hypocrystalline, hyalopilitic, with stellate (pseudo-spherulitic) arrangement.

Constituents: microlites of soda-sanidine; interstitial masses of colourless glass; stout rods of ægirine-augite, strongly pleochroic in bluish-green, olive-green, and yellowish-green; chlorite; secondary iron-ores, and occasional corroded magnetite grains.

Name: Hypocrystalline Ægirine-Trachyte.

No.X.611. Aphanitic Trachyte. Loc.: Norris's Paddock, Spring Creek.

Handspecimen: loose, compact specimen out of the tuffs; it has a rhyolitic appearance, being banded through flow-structure.

Texture: hypocrystalline; very fine and even-grained; marked off into stellate groups of minute microlites so as to have a pseudospherulitic (strahlenkörnig) fabric.

Composition; the chief constituents are the felspar (sanidine?) microlites and interstitial glass. The latter has a very low refractive index, and is light grey in colour. Idiomorphic grains of bluish-green ægirine, and small rutile rods occur sparingly. A common accessory is a yellow mineral elongated in the a direction, which coincides with crystallographic *b*: $Bx_a = a : b$ almost coincides with the *c* axis. These properties, together with the colour and pleochroism, are those of wöhlerite.

Name: Pseudospherulitic Wöhlerite(?) Ali-trachyte.

No.X.613 Biotite-Trachyte. Loc.: a dyke, with glassy selvage, between the Young and Old Man.

Handspecimen: grey, slightly vesicular, with macroscopic phenocrysts of biotite and felspar.

Texture: porphyritic-hiatal; base pseudospherulitic as in X.611.

Composition: the phenocrysts of felspar have the properties of sanidine; the microlites of the base have the same composition; the former are fractured and corroded to a great extent. The biotite is of a deep brown colour, and somewhat corroded. Small flakes of it are included in the felspars. The ægirine-augite extinguishes at 22°. It is light green and weakly pleochroic It occurs only sparingly, as fine idiomorphic phenocrysts, which are tending to decompose into red iron-ores. Minute round magnetite grains are also present in the base, as well as larger cubical grains.

Name: Pseudospherulitic Biotite-Trachyte.

C.13. Grey Trachyte. Loc.: Johnston's Pinnacle.

Texture: holocrystalline, fine-grained, porphyritic in anorthoclase; base trachytic in fabric.

Composition: felspar forms about 90 % of the rock, and consists of phenocrysts of microcline cryptoperthite, and of anorthoclase; and a second generation of laths of the same mineral, showing marked shadowy extinction. Next in abundance we have ægirine-augite, showing strong pleochroism and almost straight extinction. It occurs both as idiomorphic and allotriomorphic grains. The chief accessory is magnetite in corroded grains of various sizes. Limonite is the most abundant decomposition-product.

Name: Porphyritic Ægirine-Trachyte.

C.28. Trachyte. Loc.: summit of The Pinnacle.

Texture: holocrystalline, porphyritic-hiatal, perpatic, with even-grained trachytic base.

Composition: the felspar, consisting of a few anorthoclase phenocrysts together with the usual prismatic small laths of anorthoclase, forms about 90 %. The rest consists of micropoikilitic aggregates of cossyrite and arfvedsonite, acicular ægirines, ægirine-augite grains, corroded magnetite, red iron-ores, and a few specks of sphene(?).

Name: Porphyritic Soda-Trachyte.

C.21. A somewhat decomposed, otherwise normal, porphyritic, soda-trachyte, containing interstitially some grains of free quartz. Ferrite occurs as an abundant alteration-product of ægirine-augite and soda-amphibole. Loc.: near Bald Knob.

No.X.633. Trachyte-Porphyry. Loc.: The Pinnacle.

Handspecimen: coarsely porphyritic, iron-stained, light-coloured rock.

Texture: holocrystalline; porphyritic, dosemic; with fine-grained trachytic base.

Composition: main constituent felspar. In addition we have 2 % to 3 % of light green augite. The felspar phenocrysts are hypidiomorphic, corroded, and exhibit a shadowy extinction clearly due to ultramicroscopic twinning; frequently this is so marked as to give the appearance of the *gitter*-structure of microcline. Carlsbad twinning is well-marked. The inclusions consist of ægirine-augite and glass. Clearly these phenocrysts consist of microcline microperthite and cryptoperthite. The felspar of the base consists of the usual microlites of tabular and nephilinitoid habit, showing Carlsbad twinning; they consist of soda-sanidine, and give the base an orthophyric-trachytic fabric. The pyroxene is a colourless to light green variety of ægirine-augite, with an extinction angle of 33°.

This rock appears, from field-occurrence, to be the remnant of a sill. Its micro-structure is indicative of hypabyssal origin; for this reason we call it Porphyritic Ægirine-Augite Sölvsbergite.

No.X.648. Trachyte-Porphyry. Loc.: The Pinnacle.

Handspecimen: Miarolitic, coarsely porphyritic rock stained with iron-ores.

Texture: holocrystalline, porphyritic, serial, dosemic; base hypidiomorphic-granular, near orthophyric in fabric.

Composition : essential constituent, felspar; minor constituents, ægirine-augite, magnetite, sagenitic rutile, and secondary chalcedony. The large felspar-phenocrysts consist of microcline microperthite and cryptoperthite, as in X.633. They are often almond-shaped. The smaller phenocrysts are almost idiomorphic, and have the nephilinitoid habit, and the same composition. The corroded almond-shaped phenocrysts have a rim of clear anorthoclase. The base consists of nephilinitoid and lath-shaped microlites of anorthoclase. The next in order of abundance is a brown, non-pleochroic mineral, with concretionary structure, and a very low, yet noticeable, double refraction. This mineral is probably chalcedony stained with limonite, and may represent infilled miarolitic cavities. Limonite (secondary) occurs as strands through the phenocrysts and base alike. Magnetite occurs sparingly as round, corroded, phenocrysts. A few idiomorphic grains of light green ægirine-augite occur in the base. Sagenitic rutile and apatite are often included in the felspar. A little secondary chlorite and serpentine are also present.

Name: a typical Sölvsbergite. This rock accurs also as the plug of The Young Man.

No X.609. Porphyritic Trachyte. Loc.: Bald Hill (?)

Handspecimen : compact, porphyritic, flesh-coloured dyke-rock, with an aphanitic base.

Microscopic texture: holocrystalline; porphyritic hiatal; with micro- to crypto-crystalline trachytic base.

Composition: the essential constituent is felspar (over 90%). This is of two generations. The phenocrysts have two distinct cleavages, parallel to (010) and (001), and a parting parallel to (100). Carlsbad twinning is common; Manebach twinning also occurs; in addition faint albite-twinning is occasionally observed, and, if not, there is marked shadowy extinction due to ultramicroscopic twinning. The crystals are rounded, as in X.648, and have a rim of clear orthoclase. The refractive index is less than that of canada balsam. The habit most commonly observed is the prismatic with bc forming an angle of 88°. The faces

(001), (021), (101) and (201) are apparently best developed. The crystals are optically negative, but yet almost uniaxial in character. The extinction-angle on c (001) varies from 6° to 15° and on *b* (010) from 8° to 10°. Sagenitic rutile is a common inclusion. Evidently this generation consists of microcline cryptoperthite. The felspar of the second generation is the usual anorthoclase. Ægirine and augite are practically absent. Strands of quartz occur interstitially. A brownish-yellow, almost isotropic, titanium-mineral, surrounded by secondary leucoxene, is sparingly present. It is probably perofskite. Tridymite and fluorite both occur as accessories along miarolitic cavities. Brown and red iron-ores, and a little chlorite and kaolin occur as decomposition-products.

Name: Trachytic Quartz-Trachyte-Porphyry, or Quartz-Sölvsbergite.

No.X.619. Trachyte-Porphyry. Loc.: Dyke, Tom Cole's Farm, Parish of Waldegrave.

Handspecimen: compact, coarsely porphyritic rock.

Microscopic texture: as in X.609.

Composition: the constituents in order of decreasing abundance are (1) *essential*, felspar; (2) *minor*, ægirine, quartz, and magnetite, (3) *accessories*, zircon, fluorite; and (4) *secondary*, chalcedony and iron-ores. The felspar phenocrysts are twinned as in X.609. The extinction-angle varies from 3° to 14°. There are two good partings, and two good cleavages at about 97°. Optically negative. Clearly a variety of soda-rich anorthoclase. The usual inclusions are hæmatite, dusty garnet (?), chlorite and zircon. The second generation is also anorthoclase. The ægirine occurs as allotriomorphic corroded crystals, and as idiomorphic grains, decomposing to chlorite and iron-ores. It is highly pleochroic, and has straight extinction. In some cases a reddish-brown mass of primary hæmatite forms the nucleus of a tufty aggregate of ægirine grains. In other cases a micropoikilitic aggregate of hæmatite and felspar is seen. In such cases an original soda-amphibole aggregate has probably been pseudomorphosed into hæmatite and ægirite in the pneumatolytic period of consolidation.

Idiomorphic magnetite grains, often enveloped by secondary hæmatite, are present. Yellowish acmite occasionally forms tufty aggregates. In these a nucleus of brown soda-amphibole (cossyrite) is sometimes seen. Yellowish isotropic material is present, and may be partly glass and partly chalcedony. A few allotriomorphic quartz-grains, and grains of a colourless isotropic mineral with high refractive index are occasionally present interstitially. The latter appears to be fluorite.

The order of consolidation, as worked out from this slice, appears to be,

*1. Zircon
*2. Magnetite
*3. Felspar
*4. Hæmatite
5. Cossyrite?
6. Ægirine
7. Acmite
8. Felspar
9. Quartz
10. Fluor, chalcedony, limonite, hæmatite

Name: Quartz-Acmite-Trachyte-Porphyry.

No. X.624. Porphyritic Trachyte (or Comendite). Loc.: Pilcher's Farm.

Handspecimen: compact, light-coloured, yellowish-grey, porphyritic rock.

Texture: holocrystalline, perpatic, with micro- to cryptocrystalline, trachytic base.

Composition: the main constituent is felspar. The other minerals are acmite, iron-ores, chalcedony, opal, and perhaps a trace of glass. The dominant felspar is the usual anorthoclase. Some corroded phenocrysts have the characters of cloudy orthoclase. One corroded mass appeared to consist of four differently oriented parts, separated by wavy boundary lines; hence it is

* Intratelluric.

composed of four allotriomorphic crystals. Each part abounds in rounded vesicles partly infilled with opal, and contains liquid and gaseous bubbles too. The whole mass is surrounded by a belt of chalcedony. It is interesting because it must represent either an included crystal-aggregate through which magmatic waters dissolved their way, and deposited silica during the period of consolidation of the rock; or it represents the amygdaloidal infilling of a vesicle by a "eutectic" solution of felspar and hydrous silica, giving a micrographic intergrowth. In either case it is a good illustration of the influence of pneumatolytic action (cp. X. 649). A fair amount of yellowish acmite, in hypidiomorphic needles, is present; and also reddish iron-ores from decomposition. Tridymite (?) occurs in minute vesicles. Another isotropic colourless substance present is probably hydrous silica.

Name: Trachytic Comendite.

Note: a white rock, with bluish bands and flow-structure, from the same locality is, in handspecimen, studded with large and small vesicles, more or less infilled with white granular minerals.

C.34. Coarse porphyritic Sölvsbergite. Loc.: near The Old Woman.

Texture: holocrystalline; dosemic; the base is very fine-grained and pilotaxitic-stellate.

Composition: the phenocrysts consist of large felspars (up to ½ inch), smaller ægirine-augites, and magnetite. The felspars consist of oligoclase, with multiple twinning and refractive index greater than that of canada balsam, and the usual typical anorthoclase and microcline-microperthite. The ægirine-augite is weakly pleochroic, and extinguishes at 35°. The magnetite is titaniferous, and is accompanied by ilmenite. The base consists of the same minerals, together with secondary limonite.

Name: Oligoclase-Sölvsbergite.

B. *Melanocratic Trachytes, &c.*—These rocks are allied to the dark trachytes which occur in the Warrumbungle Mountains (*e.g.*, Timor Ledges, Nandi Mountain, Naman Ledges, &c.).

C.12. Dark greenish Trachyte. Loc.: Watt's Pinnacle.

Texture: holocrystalline; porphyritic, dopatic; base fine-grained, and pilotaxitic.

Composition: the phenocrysts consist chiefly of microcline-microperthite and anorthoclase, but smaller ones of ægirine-augite and corroded magnetite are also present. The microcline microperthite shows characteristic cross-hatching. The felspar of the base is lath-shaped soda-sanidine. The ægirine-augite occurs in strongly pleochroic, corroded idiomorphs, and also in the base as minute grains and rods. It is developing a uralitic cleavage.

Name: Pilotaxitic Ægirine-Trachyte.

C.23. Greenish Trachyte. Loc.: east of Bald Knob.

Texture: holocrystalline; porphyritic, trachytic with well marked flow-structure.

Composition: felspar forms about 80% of the rock; ægirine-augite about 15%; magnetite and other constituents about 5%. These minerals have the same characters as in C.12. The felspar and pyroxene crystallised together throughout, and hence mutually interfere with one another's crystallographic development. Secondary limonite and hæmatite are present.

Name: Trachytic Ægirine-Trachyte.

Note: the difference between melanocratic trachytes (such as C.12 and C.23) and leucocratic trachytes (such as X.631, C.13, C.28) lies neither in texture, nor in the nature of the contained minerals, but in the greater abundance of ægirine and magnetite in the former type, whereby it acquires its darker colour.

C.8. Dark green aphanitic Trachyte. Loc.: Cox's Gully, south of The Old Man.

Texture: holo- or hypocrystalline; porphyritic, perpatic; base, very fine, microcystalline, even-grained, trachytic.

Composition: the felspar phenocrysts are strongly resorbed at the edges, and are traversed by cracks filled with katapleiite. Some consist of anorthoclase, others of microcline-microperthite. They occasionally include biotite. Idiomorphic magnetite occurs in grains larger than those of the minerals of the base. The base consists of minute felspar-laths, magnetite-granules, and isotropic dark glass. In addition, this rock contains several large, six-sided, corroded masses of a yellowish colour. They seem to possess a fair cleavage, and faint pleochroism. They appear brownish by reflected light, and have an extremely high double refraction and refractive index. The extinction is shadowy, black crosses forming much the same as where crystals overlap; this feature appears to be due to a twinning lamellation. The mineral is probably a form of rutile. Nepheline may be present in the base, but has not been determined with certainty.

Name: Phonolitic Rutile (?) Trachyte.

C.26. Dark (almost black) Trachy-andesite, aphanitic in hand-specimen. Loc.: north side of Pinnacle.

Texture: porphyritic, perpatic with microcrystalline to hemi-hyaline trachytic base.

Composition: the phenocrysts consist of plagioclase varying from albite to acid andesine. The felspar of the base consists of minute lath-shaped microlites. The pyroxene consists of minute ægirine-augite laths, and grains of colourless diopside. Sphene occurs in minute rods, and magnetite in very small rounded grains. Interstitial dark glass is present. In addition, we have, in this rock, fragments of phenocrysts of *astrophyllite*, with ragged ends and typical micaceous cleavage, and a few phenocrysts of apatite. This rock appears to be a basic facies of alkaline-trachyte.

Name: Astrophyllite-bearing Trachy-Andesite.

No.X.363. Phonolitic Trachyte. Loc.: Pinnacle Road.

Handspecimen: dark, very fine-grained, aphanitic.

Texture: holocrystalline, very fine-grained, pilotaxitic.

Composition: felspar, pyroxene, sphene, magnetite, kataphorite, katapleiite and nepheline. The felspar is of two generations: (1) phenocrysts consisting of anorthoclase and microcline-microperthite, almond-shaped in outline and surrounded by a corrosion-rim, and studded with inclusions of diopside and greenish augite.

They have an extinction-angle of 8°. (2) The felspar of the base is microlitic soda-sanidine. Strands of katapleiite penetrate the phenocrysts and base alike. The pyroxene consists of phenocrysts of yellowish-green, pleochroic ægirine-augite, with extinction-angle=38°, and minute bluish, greenish, to colourless rods of ægirine-augite in the base. Sphene occurs in the base as minute lozenge-shaped prisms surrounded by leucoxene. Grains of magnetite are abundant. A few idiomorphic, corroded, nepheline phenocrysts were observed. Eucryptite(?) occurs in some of the felspar phenocrysts. A couple of poikilitic aggregates of kataphorite, with pleochroism from red to dull brown and bluish-green, occur in parts of the slide.

Name : Pilotaxitic Trachy-Phonolite.

Magmatic name : Judithose, near Laurdalose(see Analysis v.).

No.X636. Trachyte-Porphyry. Loc.: Norris's Farm, Spring Creek.

Handspecimen : compact, bluish-grey rock.

Texture: holocrystalline, porphyritic, with fine grained trachytic base.

Composition : the phenocrysts of felspar consist of microcline cryptoperthite; they are allotriomorphic, and have a zone of inclusions just within the border. The inclusions consist of ægirine-augite, magnetite, zircon, and sagenitic rutile. A second growth of clear felspar has been deposited round this zone. The felspar microlites of the base have the properties of sanidine. The pyroxene phenocrysts are yellowish-green, and have an extinction angle of 27-28°. They consist of ægirine augite. The finer, acicular microlites of the base are grass-green, and have an extinction of 18°, and are therefore more closely allied to true ægirine. Strands of katapleiite are developed in the felspar phenocrysts. Some minute yellow rods of laavenite are included in the felspar and occur also in the base. A little felspathoid is probably present in the base.

Name : Phonolitic Trachyte-Porphyry.

No.X.639. Trachyte-Porphyry. Loc.: east side of The Old Man.

Handspecimen: a reddish rock containing large, black, iridescent, irregularly cracked phenocrysts, and felspar phenocrysts, some of which are vesicular, others quite pumiceous.

Texture: holocrystalline, porphyritic, with even-grained hypidiomorphic, granular base.

Composition: the base consists essentially of untwinned nephilinitoid and prismatic felspar, decomposing to kaolin. The felspar phenocrysts are of three kinds: (1) a clear glassy sanidine; (2) a moirée microperthite, with patchy extinction; and (3) a basic labradorite. All these are broken, and surrounded with a corrosion-rim, round which a zone of orthoclase of the second generation appears.

The dark mineral is hæmatite, which has often a nucleus of magnetite, and a rim of limonite. Leucoxene occurs as a decomposition-product, indicating that the magnetite is titaniferous.

Name: the magma from which this is derived is a mixture of the typical trachytic and typical andesitic. The vesicular phenocrysts and pumiceous aggregates indicate that, after the formation of the phenocrysts, magmatic vapours, charged with acids, penetrated and leached the phenocrysts, perhaps at the same time altering magnetite to limonite.

c. *The Andesites.* The dominant type of andesite is that met with on The Old Man.

No.X.634. Black, vesicular, porphyritic Andesite. Loc.: Top of The Old Man.

Texture: holocrystalline; porphyritic, hiatal; hyalopilitic base.

Composition: the constituents are felspar, augite, ilmenite, magnetite, and glass. The phaneric felspars are twinned on the Carlsbad, Albite, and Pericline laws; zoning is frequently observed; refractive index higher than that of canada balsam; and extinction-angle 15° to 20°. The microlites of the base have apparently the same composition. This constituent is, therefore, an andesine or acid labradorite. The augite occurs in small, usually idiomorphic, but slightly corroded, phenocrysts. It is colourless, non-pleochroic, and has an extinction-angle (c' : c) of 32°. It is neatly twinned, with (100) as twinning plane. $Bx_a = c$. Optically +. Apparently it is a variety of diopside. Olivine is absent, but ilmenite occurs as small crystals. The base consists of minute, felspar needles, dusty magnetite, and glass.

Order of consolidation.

1. Ilmenite ————
2. Augite ————
3. Felspar phenocrysts ————
4. Felspar microlites ————
5. Magnetite ————
6. Glass ————

Name: Augite-Andesite.

No X.632. Compact black Porphyritic Andesite. Loc.: Hopetoun Waterfall.

Texture: holocrystalline; porphyritic, hiatal; with microcrystalline, pilotaxitic base.

Composition: the chief constituents are felspar of two generations, augite, a little olivine, and titaniferous magnetite. The felspar phenocrysts are beautifully zoned, varying in composition from oligoclase on the rim, to basic andesine or labradorite in the centre. Their other characters are as in .634. In addition they are often extremely corroded, and contain inclusions of augite and chlorite. The microlitic felspar has the properties of albite. Interstitial orthoclase also occurs. Augite does not show as phenocrysts, bnt it is abundant as idiomorphic, faintly purple, grains in the base, changing to chlorite and chloritoid. Titaniferous magnetite is abundant; a little ilmenite also occurs. Olivine is sparingly present, as corroded phenocrysts, wholly or partly altered to serpentine.

Name: Olivine-Andesite.

D. *The Basalts.* There are two types, the common olivine-basalts, and olivine-fayalite-melilite basalts.

The former type is represented by a slide of a black-grained basalt from Norris's Farm, The Canobolas. The felspar forms about 65%, and occurs as laths, varying in composition from albite to acid labradorite. Augite, of a brown to puce colour, in rounded allotrimorphic grains, and its decomposition-product, chlorite, occur to the extent of about 15%. Olivine alone occurs as phenocrysts; it is decomposing to serpentine. Small red, rounded grains of fayalite are also present. These peridotic constituents form about 10%. Ilmenite forms about 7%. The balance consists of an isotropic, light-coloured residuum, probably containing analcite, and apatite needles which penetrate the felspars and base alike.

This rock is probably an alkaline basalt. Mr. Mingaye's analysis* (i.) of Canobolas basalt, probably represents this rock-type.

The olivines have frequently felspar-laths penetrating their outer portions.

Order of consolidation.

Ilmenite ———
Olivine ———
Apatite ———
Felspar ———
Augite ———
Analcite (?) glass ———

This rock is a hyalopilitic olivine-analcite (?) basalt.

The Melilite Basalts.—The basalt from the Racecourse Quarry, near Orange, is a dark rock of typical basaltic appearance.

Texture: holocrystalline; fine and even-grained, with pilotaxitic-ophitic fabric.

Constituents (in order of decreasing abundance): felspar, augite, olivine, melilite, ilmenite, magnetite, and accessory apatite. The prismatic microlites of felspar penetrate the augite grains ophitically, and form frames round the augite, giving *microtine*

* Records Geol. Surv. N.S.Wales, 1904, Vol. vii.

structure. They are twinned on the Carlsbad and Albite laws, and have the properties of andesine. Allotriomorphic orthoclase, with shadowy extinction, seems also to be present in minute amount. The augite, in hypidiomorphic crystals, is a brownish, titaniferous variety, with extinction angle 45°. Colourless olivine occurs also in hypidiomorphic grains. A little red fayalite, ragged plates of ilmenite, and idiomorphic magnetite grains (titaniferous) are all present. Chlorite and red iron-ores occur as decomposition-products. In addition, we have some isotropic, or nearly isotropic, colourless to yellowish-green minerals lying interstitially. The chief of these has a characteristic peg-structure, indicating that it is melilite. The pegs consist of apatite, and magnetite grains are also abundantly included. As the pegs in melilite lie perpendicular to the basal plane, it is found that the mineral under discussion, if it be melilite, has α perpendicular to the *C* crystallographic axis, and is optically negative (Bx $= \alpha$). The R.I. is medium, and its D.R. very low. Shape always allotriomorphic.

Another totally isotropic, colourless constituent, probably analcite, is also present.

Order of Consolidation.

1. Ilmenite ———
2. Olivine ———
3. Augite ———
4. Felspar ———
5. Magnetite ———
6. Apatite ———
7. Melilite(?) ———
8. Glass (analcite ?) ———

Name: Ophitic Olivine-Melilite Basalt.

Note.—The rocks indicated by the letter X., followed by a reference number, belong to the Technical College Collection gathered together by Mr. Süssmilch on several visits. Those indicated by the letter C, belong to my own collection (H.I.J.).

ANALYSES.

	i. Basalt, Canobolas, by J. C. H. Mingaye.	v. Phonolitic Trachyte X.363. H. I. Jensen.	vi. Comendite X.608. H. I. Jensen.	vii. Comendite — B. White.
S_1O_2	48·92	57·39	69·23	72·06
Al_2O_3	14·87	16·88	14·58	13·86
Fe_2O_3	3·99	1·09	2·54	1·90
FeO	7·44	6·10	0·67	1·71
MgO	5·73	1·01	0·30	0·19
CaO	7·26	3·16	0·44	0·18
Na_2O	3·42	6·71†	6·82	5·84
K_2O	1·80	5·86†	3·95	3·69
H_2O(100°+)	0·82	0·11	} 0·94	0·21
H_2O(100°−)	1·56	0·49		0·33
CO_2	0·09	u.d.	—	0·03
TiO_2	2·78	1·11	0·13	0·12
P_2O5	0·59	—	—	0·06
SO_3	0·08	—	—	—
Cr_2O_3	0·01	—	—	—
NiO	0·04	0·04	0·05	abs.
MnO	0·29	0·05	tr.	0·07
BaO	0·04	—	—	—
V_2O_3	0·02	—	—	—
CuO	0·06	—	—	—
Sum ...	99·83	100·00	99·65	100·25

General Remarks.—From the foregoing petrological sketches it is clear that the Canobolas area is an alkaline petrological province. The minerals characteristic of each rock-division represented here are, generally speaking, the same as those met with in the Nandewar and Warrumbungle rocks.

The rock-types vary from the very acid comendites and pantellarites, to basic melilite-basalts, but all are derived from a magma extremely rich in Al_2O_3, TiO_2, and Na_2O.

† Owing to loss of mixed alkali by spurting, the total alkali was estimated by difference, and divided between K_2O and Na_2O in the experimentally determined ratio.

In many of the rocks the evidences of the solvent and mineralising powers of circulating acid vapours in the period of consolidation are well marked. The miarolitic nature of the plugs and dykes is also indicative that the magma was very hydrous.

In many of the comendites, quartz is not visible, but it exists nevertheless in the base in the form of opal or chalcedony, and tridymite.

The sequence is the same as in the Warrumbungles. The basic andesites cover the highest summits, and the basalts were erupted last, apparently from fissures intersecting the country surrounding the central area.

Many rare minerals have been identified in small amounts with considerable certainty. They comprise melilite, fayalite, astrophyllite, perofskite, wöhlerite, laavenite, kataphorite, and cossyrite(?).

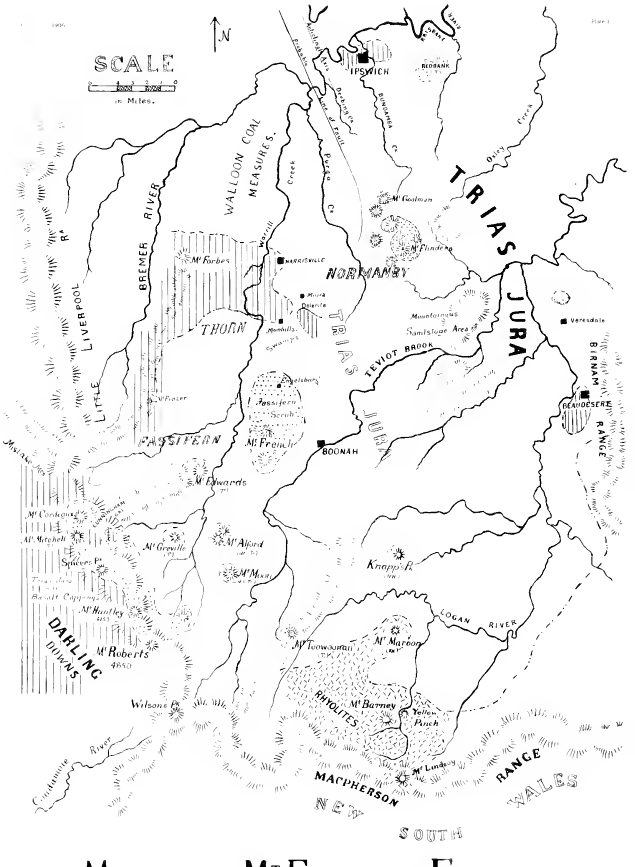
Some of the rocks described take a beautiful polish and would make excellent and most durable building-stones.

No basic tuffs, lamprophyres or basic dyke- and sill-rocks have been met with. The clastic and hypabyssal rocks all belong to the leucocratic and melanocratic *trachyte* series.

General Note.—The volcanic rocks rest in this area on a peneplain, having an altitude of about 3000 feet The basalts were erupted in some cases after the uplift and cañon-formation of the present cycle of erosion.

It has been shown by one of us (H. I. Jensen) that the Nandewar lava-flows to the west of Mt. Lindesay rest on the sandstone at an altitude of 1,800 to 2,000 feet. To the east of Mt. Lindesay and of a line running through it in a N.N.W.-S.S.E. direction, the lavas commonly have an altitude of 3,000 feet. Between the mountain-region and Narrabri the mesas average about 1,400 feet in altitude. It was shown that these discrepancies in the altitude of the peneplain are probably caused by a fold (monoclinal) due to the uplift of the New England segment, and subsidence of the earth-segment to the west, and further uplifts due to intrusions of igneous rock. This was followed by the extrusion of lavas, and subsequently step-faulting

[Printed off July 9th, 1909.]



MAP OF THE Mt FLINDERS & FASSIFERN DISTRICTS QLD.

Legend. *Trachytes* *Basalts* *Rhyolites*

[Printed off July 9th, 1909.]

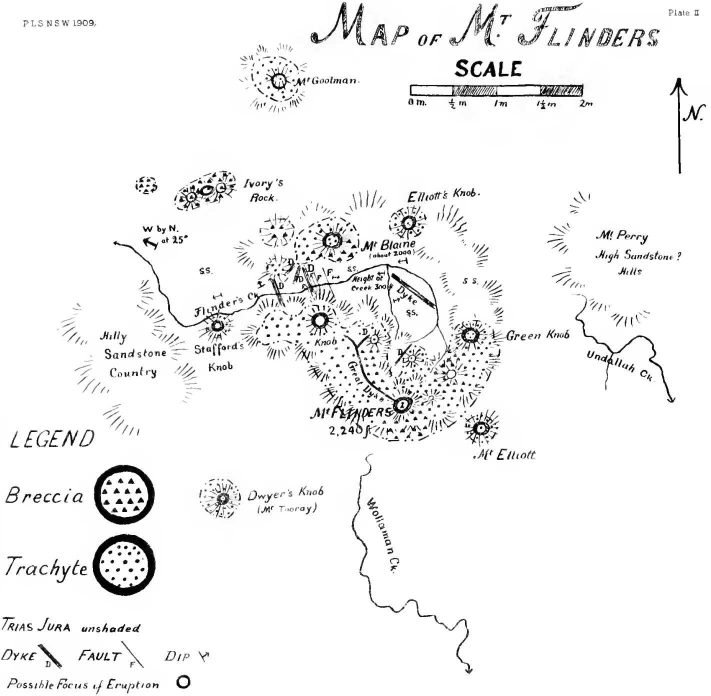

MAP OF Mt FLINDERS
SCALE
0 m.
½ m
1 m
1½ m
2 m
N.
Mt Goolman.
Ivory's Rock.
Elliott's Knob.
Mt Blaine (about 2000)
Mt Perry
High Sandstone? Hills
W by N. at 25°
SS.
S. S.
Flinder's Ck
Height of Creek 300 ft
Dyke
Great Dyke
Knob
Hilly Sandstone Country
Stafford's Knob
Green Knob
Undalluh Ck
Mt FLINDERS 2,240 ft
Mt Elliott
Dwyer's Knob (Mt Tooray)
Wollaman Ck.
LEGEND
Breccia
Trachyte
TRIAS JURA unshaded
DYKE D
FAULT F
DIP
Possible Focus of Eruption

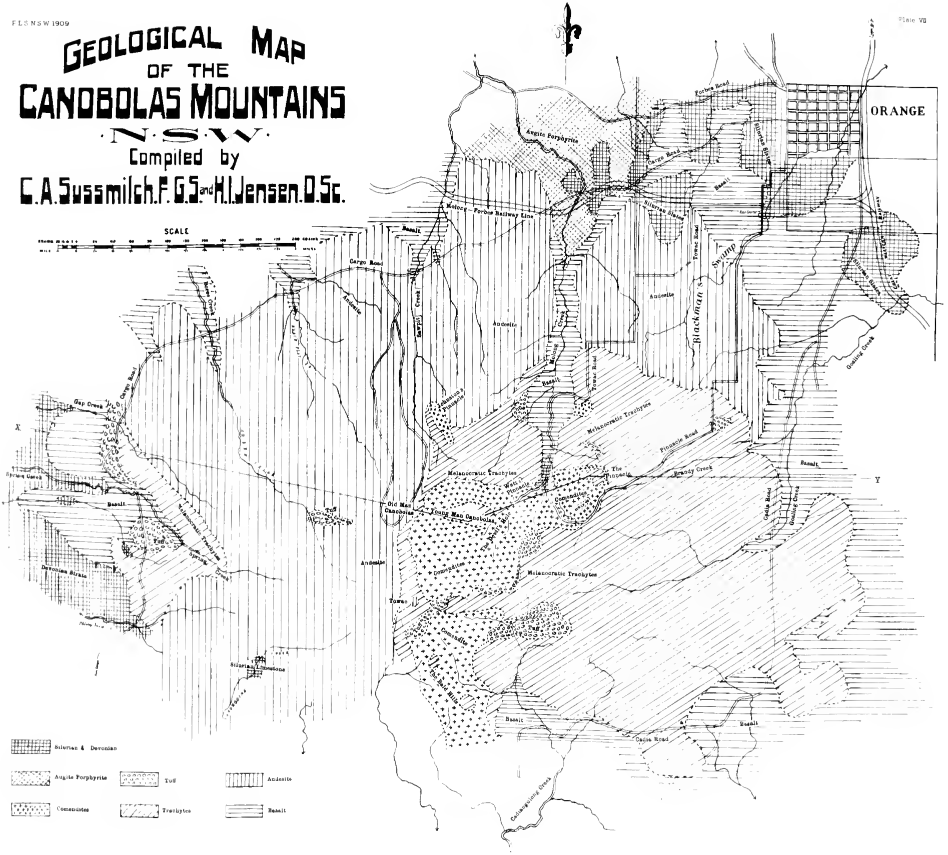
FIG. 1. MOUNT FLINDERS.

FIG. 2. THE ALUM CAVE, MOUNT FLINDERS.

MOUNT BLA NE, LOOK NG NORTH.

FIG. 1. MOUNT GOOLMAN AND IVORY'S KNOB.

FIG. 2. MOUNT BLAINE, LOOKING EAST-SOUTH-EAST


GEOLOGICAL MAP
OF THE
CANOBOLAS MOUNTAINS
·N·S·W·
Compiled by
C.A. Sussmilch. F.G.S. and H.I. Jensen. D.Sc.
SCALE
ORANGE
Forbes Road
Cargo Road
Augite Porphyrite
Silurian Slates
Basalt
Molong - Forbes Railway Line
Towac Road
Blackman's Swamp
Andesite
Boree Creek
Sawpit Creek
Molong Creek
Gosling Creek
Johnston's Pinnacle
Melanocratic Trachytes
Pinnacle Road
Gap Creek
Spring Creek
The Pinnacle
Brandy Creek
Walli Pinnacle
Comendites
Old Man Canobolas
Young Man Canobolas
The Devil's Hole
Tuff
Devonian Strata
Cadia Road
Towac
Silurian Limestone
The Bald Hills
Cadiangullong Creek
X
Y
Silurian & Devonian
Augite Porphyrite
Tuff
Andesite
Comendites
Trachytes
Basalt

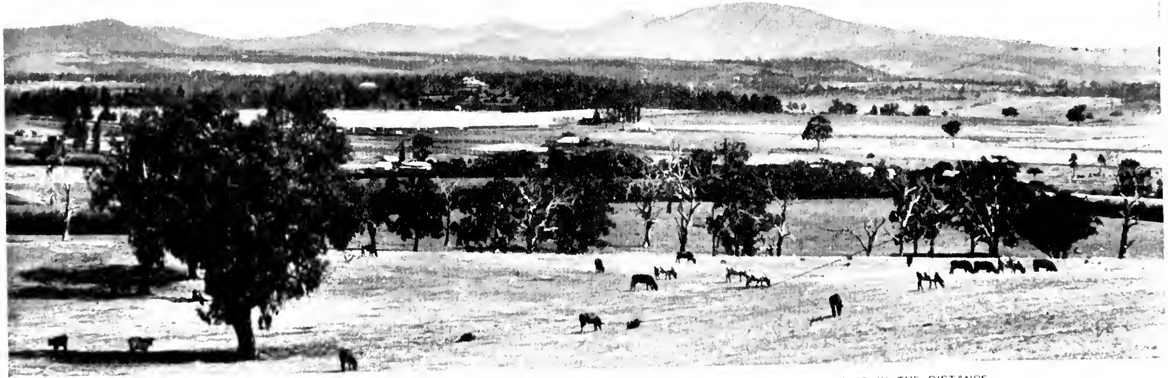


FIG. 1. THE ORANGE-BLUE MOUNTAIN PENEPLAIN IN THE FOREGROUND, WITH THE CANOBOLAS MOUNTAINS IN THE DISTANCE.

The Pinnacle. The Young Man. The Old Man.

FIG. 2. UPPER SURFACE OF AN ANDESITE FLOW IN THE FOREGROUND WITH THE CANOBOLAS MOUNTAINS IN THE DISTANCE.

HOPETOUN FALLS, CANOBOLAS MOUNTAINS.

which led to the greatest downthrow of the more westerly blocks. The level of the original peneplain is probably represented by the mesas averaging from 1,800 to 2,000 feet. The 3,000-feet level is the effect of differential uplift and hypabyssal intrusions. The 1,400-feet level is the result of downthrow, and exposure to wind-erosion in the absence of the protecting lavas. The strip on which Narrabri is situated has undergone a much greater downthrow.

To summarise, the processes have been

(a) Monoclinal folding of a peneplain, and intrusion of laccolites, leading conjointly to the formation of a conoplain superimposed on a gentle fold.

(b) Expulsion of lavas.

(c) Step-faulting with progressive downthrow to the west. Further lava-flows.

These processes cut up the original peneplain into three main levels: (1) 2,700 to 3,000 feet; (2) 1,800 to 2,000 feet; (3) 1,400 feet.

The original peneplain was probably coextensive with that on which the Warrumbungle lavas rest (elevation 2,000 feet). The latter was also arched up by intrusions so that it reaches a height of nearly 3,000 feet in the heart of the mountains. The same peneplain extends to Dubbo, where it has an altitude of about 1,000 feet, and has alkaline lavas resting on it. Probably it is this same peneplain we meet again at a level of 3,000 feet in the Canobolas Mountains.

To account for this, we have to imagine that— 1) After the period of Cretaceous sedimentation over the area between Dubbo and Bourke, all the country, for 250 miles or so from the Cretaceous shore, had been reduced to a peneplain. (2) The Cretaceous sea withdrew, either as the result of a general lowering of sea-level (Suess), or as the result of a general uplift of the whole of the continent. (3) The area occupied by the Cretaceous transgression continued to subside relatively to the rest of the continent, as a result of secular contraction; other surrounding regions were being relatively superelevated by the intrusion of laccolites, or expansion of old sediments (*e.g.*, New England, The Blue Mountains). (4) These differential movements led to gentle folding in places; to fresh faulting in other places; in others to further slipping along old fractures. In some localities lavas were expelled.

In this way an old Tertiary (early Eocene) peneplain, in this case probably the Mole Plain of New England, has been so shifted about, that to-day it occupies widely different levels in different places. Originally it was all as level as the flat country surrounding the Gulf of Carpentaria to-day.

The correlation of these peneplains, at present a matter of speculation, should prove interesting work for physiographic students.

EXPLANATION OF PLATES VII.-IX.

Plate vii.

Geological Map of the Canobolas Mountains, N.S.W.

Plate viii.

Fig.1.—The Orange-Blue Mountains Peneplain in the foreground, with the Canobolas Mountains in the distance.

Fig.2.—Upper surface of an andesite-flow in the foreground, with the Canobolas Mountains in the distance.

Plate ix.

Part of an andesite-flow—Hopetoun Falls, Canobolas Mountains.

OBSERVATIONS ON THE DEVELOPMENT OF THE MARSUPIAL SKULL.

By R. Broom, M.D., D.Sc., C.M.Z.S., Corresponding Member.

(Plates x.-xvii.)

So far as I am aware, almost nothing has been published on the development of the marsupial skull. In 1885, Kitchen Parker published his magnificent monographs on the development of the skull in the Edentata and Insectivora, and he informs us that he had intended to follow these with accounts of the skulls of the marsupials and monotremes; and we know, from various references, that he had done much work on both groups. His death, however, in 1890, interfered with his plans, and no one else has ever taken up the work.

Apart from the references in Parker's papers, almost the only work that seems to have been done on the young marsupial skull consists of various observations that have appeared in papers dealing with other points in the embryology. References to most of these will be found in the list of literature.

The present piece of work was commenced, and most of the sections cut, twelve years ago, but it was found impossible to go on with the research satisfactorily, as so little work had been done on the very early stages of other groups of the higher vertebrates. While Parker's work exhaustively treats of the later development, his methods were not suited to the study of the earliest stages. Our knowledge of the early development of the skull of even the commonest mammals is still very imperfect, and it is difficult to say whether some of the features of the marsupial development are peculiar to the group or may be common to other mammals. So far I have been able to examine and compare the early chondrocrania in *Homo, Ovis, Sus, Talpa.*

Procavia, *Gallus*, *Struthio*, *Chameleo*, *Agama*, *Scapteira*, *Eremias*, *Zonurus*, *Sphenodon* and *Testudo* among the higher vertebrates, but one or two points in the marsupial structure still remain obscure. I think it advisable, however, at this stage to publish an account of the facts of development, leaving to some later date the clearing up, if possible, of those points whose interpretation is doubtful.

The marsupial which I have chiefly studied is the diprotodont, *Trichosurus vulpecula*, of which I have a very complete series. A short account of the external and, to some extent, of the internal characters of the embryos, with figures of the more important specimens, was published some years ago by this Society. Through the kindness of my friends, Professors J. T. Wilson and J. P. Hill, I am enabled to give an account of an interesting early stage of the polyprotodont *Dasyurus viverrinus*.

TRICHOSURUS VULPECULA. Stage i.

Four embryos which may be regarded as belonging to this stage have been cut and examined. These are the embryos referred to in the above-mentioned paper as A, B, C, and E; and they vary in length from 8·5 mm. to 11 mm. In embryo A, only the back part of the head has been preserved, but the degree of chondrification does not differ greatly from that of B and C. In these latter two the cranium is well preserved, and shows very satisfactorily the early condition. The embryos are about the same size, and there are only a few points of difference in the degrees of development. Embryo E is a little in advance of the other, but not greatly. The following description of the condition of Stage i., is taken from embryo C, unless otherwise stated.

The skull at this stage is particularly interesting and, in one or two respects, unlike what was expected from Parker's work on the pig. The cranial axis is fairly well chondrified. In the occipital region it is present as a broad, curved sheet in which there are two foramina, both apparently for branches of nerve xii. A little in front of this region the basal cartilage becomes much narrowed to accommodate the auditory capsules. Between the posterior end of the capsule and the occipital cartilage is a large foramen for the passage of nerves ix., x., and xi. The auditory capsule is well developed, but chondrification has only just begun, and most of the capsule is still in the procartilage stage. It extends far up by the side of the brain, and merges in the ill-defined band of procartilage which supports the lateral wall of the brain. At the plane of the front of the auditory capsule the basal cartilage is much narrowed, but on passing a little forward it is found to again rapidly widen. The notochord ends near the point where the expansion begins. The expanded portion is about double the width of the constricted, and, towards the outer part of the expansion, there is a large oval foramen for the carotid artery. Along the outer part of the expanded part and a little distance from it, lies an elongated, oval bar of cartilage unconnected with any other, and which, as it ultimately develops into the alisphenoid bone, may be called the *alisphenoid cartilage.* A little in front of the plane of the carotid foramen, the basal cartilage becomes again narrowed, and, in the middle line, there is an oval foramen of about the same size as that for the carotid artery, which represents the pituitary fossa. In front of the fossa, for a considerable distance, the basal cartilage is very manifestly seen to be composed of two trabeculæ conjoined in the middle line. In the posterior nasal region the double origin of the cartilage becomes less marked, and from here forward, to near the front of the snout, there is little or no evidence of a double origin. Whether the whole of the nasal septum is trabecular in origin is doubtful, but the base, at least, is pretty manifestly the anterior continuation of the trabeculæ. The nasal capsule is very imperfectly chondrified, but the arrangement can be made out fairly easily. It may be described as a cylindrical structure with three openings, one at the anterior end looking outwards, the anterior nasal opening; a second opening downwards into the mouth, the internal nares ; and a third opening upwards and backwards, the opening for the nerves. The inferior opening is bounded on the inner side by a strip of cartilage or procartilage which runs along parallel to the base of the nasal septum. This is the structure which has been called by Parker the "recurrent cartilage," and by others the "paraseptal cartilage." As I think there is good reason for believing that Parker's view of its being trabecular in origin is erroneous, the latter term seems preferable.

Meckel's cartilage is pretty well chondrified and of large size. Posteriorly it passes into the badly defined condensation of cells which represents the auditory ossicles. The hyoid is a small, cartilaginous, curved rod which passes inwards to meet the median basihyal. A well defined thyroid can likewise be readily made out, also meeting the basihyal.

The relationships of many of the structures will be better understood from the actual sections than from the reconstruction; and I have, therefore, given figures of a number of the more important with brief descriptions.

Section A (Plate x., fig. 2). This section is through the anterior nares, and shows the nasal capsule imperfectly chondrified. The two capsules unite at the median septum, but whether the septum is really part of the capsule or an anterior development of the trabeculæ, is not apparent from the section. There is some reason to believe that the lower part, at least, of the septum is trabecular.

Section B (fig. 3). This is a transverse section near the middle of the nasal capsule, and through the front of the opening between the nose and the mouth. As yet the secondary palate, though in large part formed, is widely open, and the tongue lies between the two halves of it. The alinasal cartilage is well developed and slightly chondrified, as is also the septum. By the side of the base of the septum the paraseptals are distinctly seen, but imperfectly chondrified. Below the lower part of the alinasals are seen the large groups of osteoblasts about to form the maxillæ. At this plane is seen also the anterior union of Meckel's cartilages (not shown in the figure).

Section C (fig. 4) is only a short distance behind B, and is figured to show Jacobson's organ. The organ is unusually short, being seen only in eleven sections, and opens directly into the nasal cavity.

Section D (fig.5), is near the posterior end of the nasal capsule, and shows the paraseptal still of large size. The septum is only well differentiated at its base, which is clearly trabecular. The upper part is unchondrified, and may perhaps belong to the capsule. A portion of the alinasal is seen to the outer side of the nasal cavity. The section is through the anterior end of the cranial cavity and some of the branches of the olfactory nerve.

Section E (Pl.xi., fig.6) is through the pituitary opening and the anterior part of the alisphenoid cartilage. The trabeculæ are oval on section, and separated from each other. Between them the stalk of the pituitary body is seen, and above them the anterior part of the hypophysis. At some little distance outside of the trabecula and a little below the level of it, is seen the large, round, alisphenoid cartilage. It lies in the base of the palatal ridge. Outside of it and above it lies the maxillary branch of nerve v. The orbitosphenoid band, though not chondrified, can be distinctly seen.

Section F (fig.7) is through the posterior part of the alisphenoid cartilage, and shows the basal cartilage perforated for the carotid artery. Only a very small bar of cartilage lies outside of the artery. A little further out is the still rounded alisphenoid cartilage. Directly above it lies the very large Gasserian ganglion, while above the ganglion can be seen the orbitosphenoid band. The hyoid and the thyrohyal cartilages are both seen articulating with the basihyal, and below the thyrohyal the thyroid cartilage is so situated as to suggest that it is serially homologous with the hyoid and thyrohyal, and represents the second branchial arch. (They are omitted from the figure).

Sections G and H are from embryo B, as the head of this embryo has been cut so that the sections of the posterior half are more directly transverse than in embryo C.

Section G (fig.8) is through the anterior part of the auditory capsule. The basal cartilage is flat and narrow. The capsule is of large size, but not very distinctly chondrified. At the lower part the uncoiled cochlea is seen in section. Above it is a portion of the cochlear ganglion of nerve viii.; and to the outer side of this latter lies nerve vii., with its geniculate ganglion. Meckel's cartilage is at this point imperfectly chondrified.

Section H(fig.9) is through the posterior part of the capsule. Here the basal cartilage is broadening out but is still flat. The capsule is of large size, and in its upper part is seen the expanded labyrinth with, on the outer and upper sides, portions of the semicircular canals, and, at the upper and inner part, the base of the recessus labyrinthi.

TRICHOSURUS VULPECULA. Stage ii.

This stage represents the degree of development attained by the Phalanger at birth, when the embryo measures 14 mm. in greatest length. The skull is now well chondrified, and the bones of the jaws are ossified. In general structure it is as simple as in the earlier stage, but a number of the elements can now be made out with greater clearness, while some previously distinct are now fused with others.

The nasal capsule is still a simple, elongated, cartilaginous cylinder with three openings in it—an anterior external for the anterior nostril, a posterior superior for the olfactory nerves, and an inferior opening for the internal nasal opening. The nostril opens directly outwards, and is completely surrounded by cartilage above, in front, and behind. Inferiorly the nostril is imperfectly floored by a cartilaginous flap which passes forward from the base of the alinasal. There is no fenestra in the septum. The paraseptal cartilage is still complete, and runs by the side of the base of the nasal septum to the back of the nasal cavity, where it is joined by a broad bar to the base of the alinasal.

The upper and outer part of the alinasal is continued backwards as a broad cartilaginous bar lying by the side of the brain, and forming a support to it, and joins the upper part of the auditory capsule. This is the orbitosphenoid cartilage. In front, besides joining the alinasal, it also joins the basal cartilage, and a small fenestra is formed between its two attachments.

The basal cartilage, on passing back from the nasal region, broadens out gradually, and, on reaching the plane of the pituitary opening, it is found to form a very broad plate by having become united to the alisphenoid cartilage. The alisphenoid cartilage differs from that of the earlier stage in there being now seen an upward growth from near the middle of the outer side. This ascending process lies between the second and third branches of nerve v., and the Gasserian ganglion itself rests, as in the earlier stage, on the alisphenoid cartilage. The carotid foramen is still of large size, and is completely surrounded by cartilage.

The auditory capsule is large and fairly well chondrified. The lower part is oval, and the chondrification is less perfect. This part lodges the small cochlea, as yet uncoiled, and the greater part of the saccule and utricle. The upper part of the capsule is well chondrified, and is structurally continuous with the orbito-sphenoid bar. It protects the upper part of the utricle and the semicircular canals. The fenestra ovalis is situated a little below the middle of the capsule. From the upper part of the capsule there is given off a cartilaginous ridge which passes downwards and protects the tympanum. This is the tegmen tympani. It is not quite clear whether it is a part of the auditory capsule or a process from the exoccipital.

Behind the lower part of the capsule there is an elongated fenestra for the passage of nerves ix., x., and xi. The occipital cartilage behind this is broad and well developed. There are two foramina, both apparently for nerve xii. There is no apparent differentiation between the basioccipital and the exoccipital, but the supraoccipital can be demarcated from the exoccipital.

Meckel's cartilage is well chondrified, and is continuous with the anterior process of the malleus. The malleus is fairly large, but the capitulum is not very marked, and the manubrium rather short and directed markedly inwards. The incus articulates with the malleus in the usual manner, and is of the usual mammalian shape. The stapes is large and is perforated.

The hyoid articulates in part with the processus longus of the incus, and in part with the margin of the tegmen tympani.

The premaxillary bone is partly ossified. It forms a support for the germs of the incisor teeth, and a floor for the anterior part of the nasal capsule. In the cleft between the nasal capsules in front there are indications of an ascending internasal process, as in reptiles. The process is not ossified, but the strand of differentiated cells, perhaps degenerate osteoblasts, can be easily traced into the region to be occupied by the nasal bone.

The maxilla is a triangular-shaped bone when viewed from below. It is most developed in the region of the teeth-germs, but the secondary palate is well formed. The roof of the mouth is markedly concave.

The palatine is well ossified and forms the walls of the posterior nares. The portion which forms the secondary palate is the larger.

The pterygoid is still small, and only partly ossified. It rests on the lower part of the anterior end of the alisphenoid cartilage.

The jugal, the lachrymal, and the squamosal are beginning to ossify, but too imperfectly to be drawn.

The mandible is well ossified and of large size. At its posterior end the coronoid process and the angle are already typically formed, and the articular condyle is made up of cells somewhat like imperfectly formed cartilage-cells, but there is no distinct cartilage.

The following series of sections will illustrate the relationships of the more important structures. Section A is from the unborn embryo described and figured as embryo F. All the other sections are from the newly born embryo described and figured as embryo H.

Section A (Pl. xiii., fig. 13). This section has been figured from the unborn specimen as, owing to the different staining, the cells of the developing premaxilla are better seen. The section is through the front part of the anterior nares. Part of the capsule is seen as a half ring, which is a short distance apart from that of the opposite side. Between the two cartilages are seen the strands of cells which represent the ascending internasal processes of the premaxillæ.

Section B (fig.14) is through near the middle of the external nares. The nasal capsules are seen joined in the middle line. A portion of the premaxilla is seen below the base of the cartilage. The flap of cartilage, which passes forwards and forms a floor to the nostril, is cut across. In the lower jaw (not figured) the symphysis of Meckel's cartilages is seen, and a portion of the dentary.

Section C(fig.15) is through the posterior border of the nostril. The nasal septum now shows no sign of having a double origin. Inferiorly it passes far down towards the papilla palatina, and is wedged between the premaxillary bones. The cartilage of the nasal floor extends inwards to the base of the septum, against which it abuts. Above its outer end is a small triangular piece of cartilage which stretches across from the alinasal at the back of the nasal opening, to the nasal floor-cartilage. The front of the maxilla is cut across.

Section D(fig.16) is through the posterior part of the nasal capsule. The alinasal cartilage is open above; and, attached to its upper part, is the large orbitosphenoid cartilage. The lower part is short and thick. The paraseptal is seen joining on to the middle region of the alinasal. The median or septal cartilage is short and broad. The maxilla appears to be much thickened, but this is due to the secondary palate being cut obliquely. The lachrymal can be detected, but it is not yet ossified.

Section E (Pl.xiv., fig.17) shows the relations of parts at the anterior end of the alisphenoid. The basal cartilage is partly divided by the almost obliterated pituitary canal. External to it lies the rounded alisphenoid. Above the alisphenoid is seen the second branch of nerve v., and further up the well developed orbito-sphenoid cartilage.

Section F(fig.18) is through the middle of the alisphenoid cartilage. At this stage the cartilage differs from that of the earlier in having an upward growth towards the orbitosphenoid on the outside of the Gasserian ganglion. Though the alisphenoid is partly fused with the basal cartilage, the division is still well marked. Meckel's cartilage is of large size, and has the dentary lying on its outer side.

Section G(fig.19) shows the relation of parts at the posterior end of the alisphenoid. The basal cartilage is perforated by the carotid artery, and the alisphenoid lies partly below the outer portion. The Gasserian ganglion is here of large size, and fills in the whole space between the basal cartilage, the alisphenoid, and the orbitosphenoid.

Section H(fig.20) is through the anterior part of the auditory capsule. The basal cartilage is a broad, fairly thick, flat plate. To its outer side is attached the auditory capsule, which here contains the cochlea. The anterior end of the cochlea is curved outwards, and the section is across the curved portion. There is no coiling as yet, the curve forming less than a semicircle. Resting on the outer side of the auditory capsule is the geniculate ganglion of nerve vii. A little outside of the ganglion is the malleus cut in section. Below the malleus and the auditory capsule is seen the Eustachian canal and tympanic cavity, and a little external to this is the external auditory meatus filled with epithelium. The orbitosphenoid is much smaller than in the anterior sections. Inferiorly both the hyoid and the thyrohyal cartilages are seen in section.

Section I(Pl.xv., fig.21) is through the middle of the auditory capsule. The section does not differ very greatly from the preceding The upper part of the capsule is now seen united with the posterior part of the orbitosphenoid bar. The utricle, saccule, and posterior end of the cochlea are seen in section. Portions of the incus and stapes are shown, and internally much of nerve viii., is seen.

Section J(fig.22) is considerably further back than Section I. The utricle and the ductus endolymphaticus are seen lying side by side inside the upper part of the cartilaginous auditory capsule. Two semicircular canals are seen in section. The lower part of the auditory capsule has almost disappeared. The basal cartilage is now much broader; and, in the space between it and the auditory capsule, is seen the ganglion of nerve x. On the outside of the capsule is seen the tegmen tympani, which, in this section, is differentiated from the capsule. Above, the capsule is continued into a slender bar of cartilage, from which it is somewhat differentiated. When the whole series of sections is traced, this cartilage is seen to be continuous with the supraoccipital behind, and in front it becomes merged in the cartilage which may be either the upper part of the auditory capsule, or the posterior part of the orbitosphenoid.

Section K(fig.23) is through the posterior part of the capsule. The section is interesting as showing that the capsule is here very distinct from the supraoccipital above, and from the basal cartilage below. To the inner side of the capsule lies the ductus endolymphaticus. In the lower part of the large basal cartilage is seen the posterior of the two foramina for nerve xii.

Section L(fig.24) is a little behind the previous one, and shows the supraoccipital, now of large size and united with the outer part of the basal cartilage, which may be regarded as the exoccipital. On the inside of the supraoccipital lies the large saccus endolymphaticus.

Dasyurus viverrinus. Stage ii.

The earliest stage of the Native Cat which I have been able to study, is a mammary fœtus probably but a few days old. The head measures 4 mm., and the greatest length in the curved position 8 mm. Though much smaller than *Trichosurus* at birth, it is quite as well developed, the cartilages being well chondrified and many of the cranial bones ossified. Though the skulls of the two types of marsupials are in the main essentially similar, the differences are very much greater than one would be inclined to expect.

The general structure of the chondrocranium will be most readily understood by examining figures 25 and 26 (Plate xiv.) and comparing them with those of the early cartilaginous skulls of *Trichosurus.* Relatively in *Dasyurus* the nasal portion of the skull is much larger, the orbitosphenoid much broader, and the inferior part of the auditory capsule much smaller than in *Trichosurus.* But besides these differences in degree of development there are a number of points of difference of a more fundamental nature.

The nasal capsule has the anterior nares relatively further forward than in *Trichosurus*, so that, whereas in the latter the premaxilla lies underneath the middle of the opening, in *Dasyurus* the whole of the opening is in front of the bone. There is a further difference in that while *Trichosurus* has a very imperfect cartilaginous floor, in *Dasyurus* the floor is well developed. The paraseptal cartilages are large in front, and pass backwards to near the end of the nasal capsule; but posteriorly they do not fuse with the back part of the capsule as in *Trichosurus*. Posteriorly the nasal cartilages fuse with the median cartilage and form a broad, flat, cranial floor.

At this stage the alisphenoids are, as in the second stage of *Trichosurus*, fused to the cranial floor-cartilage. They are, however, clearly differentiated from the median cartilage. From the anterior and outer corner there passes upwards, outwards, and forwards, a slender cartilaginous process which, at its upper end, joins with the orbitosphenoid cartilage. Though in a number of respects unlike the ascending process seen in *Trichosurus*, it is doubtless homologous with it, as in each case the cartilage lies between the second and third branches of nerve v. The carotid foramen is relatively smaller in *Dasyurus*.

The orbitosphenoid cartilage is very large, and is completely fused with the nasal capsule in front and the auditory capsule behind. Less distinctly it is continued into the supraoccipital.

Owing to the imperfectly developed state of the cochlea at this stage, the lower part of the auditory capsule is small, but the upper part containing the semicircular canals is quite as large as in *Trichosurus*.

The occipital region is relatively short. There are two foramina for nerve xii., and a large opening is left in front for nerves ix., x., and xi. The occipital cartilage meets the auditory, but does not fuse with it, except above the level of the semicircular canal.

The premaxillary maxilla, palatine, pterygoid, jugal, and the mandible are all ossified at this stage. The premaxilla is small, and situated far behind the anterior part of the nasal cartilage. The maxilla is flat, but has two well marked ridges bounding the dental region. The secondary palate is but imperfectly developed. The palatine is large, and forms a good secondary palate. The pterygoid is very small, and, as in *Trichosurus*, develops in connection with the alisphenoid cartilage.

The malleus, incus, and stapes are shown in fig.26*a*(Plate xvi.). The manubrium of the malleus is not fully chondrified. The incus is not unlike that of the higher mammals. The elements are relatively large.

In Plate xvii., are shown six typical sections through the head of the young *Dasyurus*. The head was cut into 305 sections, and the number of the section will indicate the plane.

Section A(fig.47) is the 44th of the series. It passes through the external nasal opening, and shows the condition of the nasal cartilages. The great development of epithelium inside and outside of the mouth, with the fusing of the lips, are well seen.

Section B(fig.28) is the 75th, and in a plane immediately behind the nasopalatine canal. It shows the nasal septum no longer attached to the alinasal, while the upper part of this latter is passing into the large, lateral orbitosphenoid cartilage. Below the organs of Jacobson lie the paraseptals. The maxillary bone is seen in section with a small secondary palatal plate. Below the tongue is seen the developing mandible, which is ossified considerably in advance of Meckel's cartilage, appearing in the 60th section, while the cartilage only appears at the 85th.

Section C(fig.29) is the 122nd, and passes through the middle of the eye. The median cartilage is here broadened out, and fused with the back part of the alinasal. The orbitosphenoid is large, aad appears fused to the median cartilage. The upper two-thirds are well chondrified, but the lower third partly fibrous Portions of the maxilla are seen, and the small jugal is cut across. In the lower jaw Meckel's cartilage is shown, with the mandibular ossification lying on and above it.

Section D(fig.30) is Section No.173. The median cartilage is broad, and is pierced by the foramen for the carotid. The alisphenoid cartilage is small, and closely united to the basal cartilage. On its inner and under side lies the ossifying pterygoid. Meckel's cartilage is seen cut obliquely as it passes up to unite with the malleus. The mandible is still seen in close connection with it. The orbitosphenoid is now far removed from the lower cartilages, and forms a protecting shield for the side of the brain.

Section E(fig.31) represents Section No.204. It cuts the anterior part of the auditory capsule, the lower part of which is seen supporting the cochlea. Above the cochlea is the ganglion of nerve vii. The upper part of the auditory capsule is seen united to the posterior continuation of the orbitosphenoid cartilage. Both malleus and incus are cut across in the section, and the tympanic cavity, the Eustachian tube, and the external auditory passage are seen.

Section F(fig.32), representing Section No.225, is through near the middle of the auditory capsule. The cochlea, with its nerve and ganglion, is well seen, also one of the semicircular canals. The upper part of the auditory capsule is, as in the previous section, united with the continuation of the orbitosphenoid, and this can be traced right over the brain to join that of the other side. The hyoid and thyroid cartilages are cut across.

Comparison of the Marsupial Primordial Skull with that of the Monotreme.

Since the greater part of this paper has been prepared, and on the eve of its being sent off, I have fortunately been enabled to consult Gaupp's magnificent paper on the early skull of Echidna, which has just appeared this year. It is probably better to leave the main part of my paper exactly as it stands, as most of the conclusions have been arrived at quite independently of any previous work by others. Had I previously seen Gaupp's paper, I should quite probably have adopted one or two of his terms in preference to those used here, and for certain structures to which

I have given no name; but, on the whole, my paper would have remained much as it is. Whether morphologists accept all Gaupp's conclusions or not, all must be most grateful for a most beautiful piece of conscientious work.

When one compares the skull of the very young *Echidna* with that of the young *Dasyurus*, one is at once struck by the remarkable similarity between the two. In fact the Dasyure skull resembles that of *Echidna* more than it does that of *Trichosurus*.

Echidna agrees with *Dasyurus* in having a broad, flat, nasal floor-cartilage (*solum nasi*), and in having the paraseptal cartilages ending in a point. There is an absence in *Dasyurus* of the palatine-process of the solum nasi, seen in *Echidna*. The nasal capsule behind joins the median cartilage in much the same way in both.

The cartilage which I have called the alisphenoid, Gaupp calls the *ala temporalis*. It is similarly situated in the Dasyure and *Echidna*, but the marsupials reveal the meaning of the structure much better than the monotreme. In *Echidna* there is a small cartilaginous process passing upwards and forwards to join the orbitosphenoid, but this is apparently not homologous with the process in *Dasyurus*. The position of the carotid foramina differs somewhat, being much nearer the middle line in *Echidna*. The marsupial condition is thus intermediate between the monotreme and the eutherian.

The parachordal region in *Echidna* is a little narrower than in *Trichosurus*, and much narrower than in *Dasyurus*. The occipital cartilage differs in having, in the marsupials, two foramina for nerve xii.; while, in *Echidna*, nerve xii. passes, according to Gaupp, with x. and xi., through the jugular foramen.

The auditory capsules resemble each other in the two groups owing to the cochlea being simply curved and not coiled in either. The section shown by Gaupp in Plate lxxii., fig.19, should be compared with my fig.31, and the near affinity of the monotreme and the marsupial will be manifest. In all essential features there is close agreement.

The large lateral cartilage which I have referred to as the orbitosphenoid, Gaupp calls by various names. The anterior part he calls the *ala orbitalis.* A little further back it is called the *commissura orbito-parietalis*; while, when it passes above the auditory capsule, it becomes the *lamina supracapsularis.* In *Echidna*, however, the cartilage is essentially similar to that in the marsupials.

The monotreme auditory "ossicles" chiefly differ in the small size of the incus.

Comparison of the Marsupial Primordial Skull with that of the Eutheria.

Much more work requires to be done before anything like a satisfactory comparison can be made, and the Eutherian orders appear to differ about as much from one another as the marsupial does from them. As soon as I can obtain some leisure from more pressing other work, I hope to give reconstructions of the very early skulls of a number of types.

In the eutherians the most noticeable character is the large size of the cochlea which, even before chondrification, is coiled, so that the lower part of the capsule is always large. The orbitosphenoid cartilage extends the whole way from the nasal to the auditory capsules, but is usually smaller than in the marsupials; and the optic nerve passes through it. The paraseptal cartilage never, so far as known, unites with the capsule behind, as in the Diprotodonts. The alisphenoid cartilage is always apparently present, as in marsupials; and is, as in marsupials, quite a distinct cartilage originally. There is good reason to believe that it is this cartilage that Parker, in his work on the pig's skull, took for the palatopterygoid. The carotids in the higher mammals do not pierce the basal cartilage, and nerve xii. has only a single foramen.

The Fundamental Structure of the Mammalian Skull.

The study of the early development of the marsupial and eutherian skulls leads one to differ considerably from the conclusions of Parker as to the fundamental structure of the skull. The vertebrate skull is usually regarded as made up of the following elements—a pair of parachordals, a pair of trabeculæ, a pair of nasal capsules, a pair of ear-capsules, and a series of visceral arches, with secondary developments of these. By many, the occipital elements are looked upon as a cranial vertebra and distinct from the parachordals. It might seem unlikely that the development of the skull of the mammalia—the highest group of the vertebrates—should reveal the fundamental structure more clearly than that of the lower groups; but, as regards the skull, the mammal is much simpler than the reptile, and less degenerate than the living amphibians. In *Trichosurus* the elements are more easily differentiated than in *Dasyurus*, presumably because the embryo is considerably larger when chondrification begins; and, in some of the Eutheria, points can be made out which are obscure in the marsupials.

The parachordals and trabeculæ are very definite structures, but the occipital region is not very clearly differentiated from the parachordal. The trabeculæ form all the median, basal cartilage in front of the parachordals. There is good reason to believe, however, that the paraseptals are not recurrent trabecular cornua, as supposed by Parker, but true parts of the nasal capsule, and probably only the base of the nasal septum is trabecular, the upper portion being part of the nasal capsule. The large lateral cartilage, which I have spoken of as the orbitosphenoid, seems to be as definitely a cranial element as the trabecula. It passes from the nasal capsule backwards, forming a lateral wall to the brain; and, while in *Echidna* and the marsupials it fuses with the auditory capsule, forming the *lamina supracapsularis* of Gaupp, it is manifest from some of the eutherian embryos that it is quite a distinct element from the auditory capsule, only uniting with it late. There is also some reason to consider that the supraoccipital is the further continuation of the same band.

The alisphenoid cartilage (*ala temporalis* of Gaupp) in the marsupials and eutherians first appears as a distinct cartilaginous rod which lies below the Gasserian ganglion. It afterwards unites with the outer edge of the trabecula. Still later, a process grows up between the maxillary and mandibular branches of nerve v., and gradually it ossifies into the alisphenoid bone. There is thus no doubt as to its later history: the difficulty is to be certain of its homologies in lower vertebrates. It is undoubtedly not trabecular, and, among reptiles, the only cartilage with which it seems comparable is the palatopterygoid. At first sight this may seem a startling conclusion, but there is much to be said in its favour. In *Sphenodon*, the most primitive reptile which we can examine, and the one nearest to the mammal-like reptiles from which the mammals sprang, we find a bar of cartilage bearing the same relations to the trabecula as the alisphenoid cartilage does in the marsupial. This is the horizontal portion of the palatopterygoid arch. The resemblance is obscured by the development of the upward-passing epipterygoid. When, however, the epipterygoid is aborted, as in *Chameleo*, we get a short cartilaginous bar almost exactly similar. In the snakes the same cartilage gives rise to the so-called alisphenoid bone. In the Crocodilia we again get an alisphenoid bone; and in the Chelonia a small bone which some regard as alisphenoid, others as an epipterygoid. Even among extinct reptiles we get either an alisphenoid or an epipterygoid, but never both. In the Therocephalia and Anomodontia there is a typical epipterygoid; in the Cynodontia a fan-shaped bone takes its place, and in the mammal this becomes the bone we call the alisphenoid.

We may thus conclude that the element which develops into the alisphenoid is a specialisation of a rudiment of the palatopterygoid arch.

LITERATURE.

In Gaupp's paper is given a list of the most important papers on the development of the skull of the higher vertebrates.

[Gaupp, E.—"Zur Entwickelungsgeschichte und vergleichenden Morphologie des Schadels von Echidna aculeata var. typica." Semon's Zoologische Forschungsreisen in Australien, &c., iii. Band, 4 Lief., p.782 (1908)].

REFERENCES TO PLATES X.-XVII.

al.n., alinasal—*a.n.*, anterior nares—*a.Pmx.*, trace of the premaxillary extending round the front of the nasal capsule—*a.s* , alisphenoid—*aud.*, auditory capsule—*b.hy.*, basihyal—*car.*, carotid artery—*c.f.*, carotid foramen—*coch.*, cochlea—*conj.*, conjunctiva—*D.*, dentary—*d.e.l.*, ductus endolymphaticus—*d.l.*, dental lamina—*e.a.c.*, external auditory canal—*e o.*, exoccipital—*f.e.*, foramen epiphaniale—*G.g.*, Gasserian ganglion—*hy.*, hyoid—*in.*, incus—*J.o.*, Jacobson's organ—*Ju.*, jugal—*lab.*, labyrinth—*ma.*, malleus—*Mk.*, Meckel's cartilage—*Mx.*, maxilla—*n.s.*, nasal septum—*o.s.*, orbitosphenoid—*Pa.*, palatine—*pit.*, pituitary—*Pmx.*, premaxilla—*p.s.*, paraseptal cartilage—*Pt.*, pterygoid—*s.e.l.*, saccus endolymphaticus—*s.o.*, supraoccipital—*s.p.*, secondary palate—*thy.*, thyro-hyal—*tr.*, trabecula—*t.t.*, tegmen tympani—*tymp.*, tympanic cavity—*ut.*, utricle; v., vii., viii., ix., x., xi., xii., cranial nerves—vii.*g*, ganglion of nerve vii.—viii.*c*, cochlear ganglion of nerve viii.

Plate x.

Fig.1.—Underview of reconstruction of the skull of a 10 mm. intrauterine fœtus of *Trichosurus vulpecula*(× 22). The parts outlined are distinctly chondrified; in those parts which are coloured, but with dotted outlines, chondrification is imperfect; the parts shaded but not coloured are not chondrified.

Figs.2-5.—Sections through the snout of 10 mm. *Trichosurus* embryo(× 30).

Plate xi.

Figs.6-7.—Sections through the alisphenoid region of the head of 10 mm. *Trichosurus* embryo(× 30).

Figs.8-9.—Sections through the ear-region of head of a different specimen of 10 mm. *Trichosurus* embryo. Cut in different direction(×   ).

Plate xii.

Fig.10.—Under view of reconstruction of skull of 14 mm. mammary fœtus of *Trichosurus vulpecula*(× 30). The membrane bones are removed from the right side; and Meckel's cartilage, the malleus, incus, stapes and hyoid from both sides.

Fig.11.—Side view of same(× 30).

Fig.11*a*.—Malleus, incus, and stapes of ditto.

Plate xiii.

Figs.13-16.—Sections through the anterior part of the head of 14 mm. mammary fœtus of *Trichosurus vulpecula*(× 45).

Plate xiv.

Figs.17-20.—Sections through the middle region of the head of 14 mm. mammary fœtus of *Trichosurus vulpecula*(× 30).

Plate xv.

Figs. 21-24.—Sections through the posterior part of the head of 14 mm. mammary fœtus of *Trichosurus vulpecula* (× 30).

Plate xvi.

Fig. 25.—Underview of reconstruction of the skull of 8 mm. mammary fœtus of *Dasyurus viverrinus* (× 40). The membrane bones have been removed from the right side; and Meckel's cartilage, the malleus, incus, stapes, and hyoid from both sides.

Fig. 26.—Side view of same (× 40).

Fig. 26*a*.—Malleus, incus, and stapes of same.

Plate xvii.

Figs. 27-32.—Sections through the skull of 8 mm. mammary fœtus of *Dasyurus viverrinus* (× 30).

WEDNESDAY, MAY 26TH, 1909.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, May 26th, 1909.

Mr. C. Hedley, F.L.S., President, in the Chair.

Mr. Arthur Bache Walkom, Ashfield, was elected a Member of the Society.

A letter was read from Professor T. W. Edgeworth David, addressed to Mr. A. H. S. Lucas, returning thanks for the congratulations and message of welcome tendered to him at the Lord Mayor's Reception on the occasion of his return from Antarctica with the British Antarctic Expedition, 1907, by the retiring President on the Society's behalf.

A letter was read from the President of the University of Sydney Medical Society, commending to the notice of Members the projected Memorial of the late Dr. T. C. Parkinson, who died in January last from accidental infection while carrying on investigations in connection with the Indian Plague Commission.

The President called attention to a Special General Meeting to be held on 30th June, 1909, at 8 o'clock (before the Ordinary Monthly Meeting on the same date). *Business*: to consider the amendment of Rules ii., iii., iv., vi., viii., and xlvii., with a view to the admission of Women to full Membership. [A special circular giving details was issued to Members with the Abstract.]

The President offered the Society's congratulations to Dr. H. I. Jensen, to whom the Syme Prize for the encouragement of Research Work in Natural Science had recently been awarded by the University of Melbourne.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 9 Vols., 85 Parts or Nos., 25 Bulletins, 2 Reports, and 27 Pamphlets, received from 59 Societies, &c., and 2 Individuals were laid upon the table.

NOTES AND EXHIBITS.

The President, on behalf of Mr. B. Jardine, of Somerset, showed a fine pearl adherent to a valve of the pearl-shell.

Mr. Froggatt exhibited a series of stages in the life-history of the Mexican Cotton Boll Weevil (*Anthonomis grandis*) mounted for educational purposes. Also specimens of the larva of a water-beetle and a Nematode worm (*Gordius* sp.) found in the stomach of a trout from Cooma, N.S.W.

Mr. W. S. Dun exhibited a specimen of *Lingula* (sp.nov.) from the Lower Marine Stage of the Permo Carboniferous at Ravensfield, near West Maitland. The form appears to be more closely allied to certain Silurian species than to those of the Upper Palæozoic. J. D. Dana recorded *L obovata* from the Upper Marine Stage of Gerringong (Geology Wilkes' Exped.). The genus is apparently rare in the Permo-Carboniferous.

Mr. Maiden exhibited specimens of the roots of the Native Cherry (*Exocarpus cupressiformis*) showing haustoria.

Dr. J. B. Cleland exhibited a series of anatomical specimens in illustration of his remarks on the Illawarra Red-water of cattle. This disease is confined, and seems peculiar, to the southern coastal districts of New South Wales. It is popularly called Red-water, or (to distinguish it from the Red-water due to the organism transmitted by cattle ticks) South Coast Red-water. The use of the term "South Coast Red-water" is apt to confuse it with somewhat similar diseases, as regards the colour of the urine, occurring in South Africa. Illawarra Red-water, therefore, would be a better name. The disease may be described as a hæmaturia due to the bleeding from multiple, muriform, teleangiectatic growths in the bladder, with consequent secondary anæmia, followed by accidents due to clotting of the blood in the bladder, and subsequent bacterial infections, &c. From the absence of signs of bacterial infection of the bladder in early cases from the failure to find any parasitic worm, such as *Bilharzia*, in the bladder-walls, and from the appearances presented, *post-mortem*, by the bladder, the conclusion seems to be justified that the disease is due to the effect of some toxin. This view is the more remarkable in that there is no evidence of toxic action elsewhere, even in the kidneys; and in that the bladder, so far as known, is neither an absorptive nor eliminating organ. Amongst the workers in one of the coal-tar dye-industries it is said that growths of a malignant nature in the bladder are not uncommon, which, if the case, would support the toxic theory. It may be that the poison, after rapid elimination by the kidneys, has time to exert a baneful influence while stored in the bladder. A popular view in the South Coast is that the plant *Indigofera australis* is to blame for the condition. Another plant suggested by Mr. Hamilton is *Omalanthus*; and Mr. Maiden had been good enough to furnish notes on references to the supposed poisonous effect on cattle of both these plants. Therein it is stated that, in 1894, Mr. Holtze attributed Red-water in the Northern Territory to a species of *Omalanthus*. The opportunity of consulting the original paper is lacking; but it is possible that the cases were really due to Piroplasmosis. Such parasites are absent from the Illawarra cases, however. Experiments are now in progress to test the poisonous action of both the plants in question. In the meantime, information or aid which will help in unravelling the etiology of this interesting and obscure disease will be very acceptable.

Mr. T. Harvey Johnston, of the Bureau of Microbiology, exhibited specimens of following species of Entozoa from New South Wales (unless otherwise stated). The presence of many of these is now recorded for the first time. A collection from local horses included *Anoplocephala mamillana* (Mehlis), *A. perfoliata* (Goeze) and *A. plicata* (Rud.), *Oxyuris curvula* Rud., *Ascaris megalocephala* (Cloq.), *Sclerostomum* (*Cylichnostomum*) *tetracanthum* (Mehlis), *S. edentatum* Looss.(=*S. equinum* Mull., in part), *Spiroptera microstoma* (Schn.) and *S. megastoma* (Rud.). *Echinococcus polymorphus* Dies., was recently taken from the liver of a horse at Berry by Dr. Cleland (also of the Bureau); the only other Australian record of the occurrence of this parasite in the horse was one by Miss Sweet, D.Sc., who examined Victorian specimens from the kidney. Dr. Cleland also collected examples of the larvæ of *Gastrophilus nasalis* (Linn.) from the duodenum, the usual habitat being the stomach. Other Entozoa included three species of *Trichocephalus*, viz., *T. nodosus* Rud., from rats (*Mus rattus*) and mice (*Mus musculus*); *T. crenatus* Rud., from the pig; and *T. affinis* Rud., from sheep and cattle. The first species had not been previously recorded from Australia, and the second species only once (Perrie, 1892, in New South Wales). Another species belonging to the same family (*Trichotrachelidæ*) of Nematodes as the above, viz., *Trichosoma hepatica* (Bancr.) occurs very commonly in the liver of local rats and mice (*Mus rattus*, *M. alexandrinus*, *M. decumanus*, *M. musculus*). It has not been previously recorded from this State. Dr. Bancroft described it from Brisbane rats (*M. rattus*), and Dr. Cleland indicated its presence (though without naming it) in West Australian rats (*M. rattus*). The above thus probably constitute the first records of the occurrence of this parasite in *M. decumanus* and *M. musculus* in Australia. *Spiroptera obtusa* Rud., a common parasite in the stomach of the above four species of *Mus* in Sydney, had not been previously reported from the Commonwealth. Three species of the Cestode genus *Hymenolepis* were exhibited. *H.* (*Drepanidotaenia*) *lanceolata* (Bloch) from the goose; *H. murina* (Duj.) from *Mus decumanus*, *M. rattus* and *M. musculus*; and *H. diminuta* (Rud.), fairly common in the intestine of the same three species of *Mus*, and rarely in *M. alexandrinus*. None of these tapeworms had been previously recorded from the continent. This last remark also applied to *Gigantorhynchus moniliformis* Bremser, which occurs fairly commonly in *Mus rattus* and occasionally in *M. decumanus* in Sydney. *Haemogregarina* (*Leucocytozoon*) *muris* Balf., was recently found in the leucocytes of a rat (*Mus decumanus*) which was also infested by *Trypanosoma lewisi*. The only other Australian reference to this interesting parasite was one by Dr. Cleland, who found it in West Australia. *Haemonchus contortus* (Rud.) from sheep, *Anoplocephala plicata* (Rud.) from the horse, and *Dipylidium caninum* (Linn.) from the cat, all collected by Dr. Cleland, were reported for the first time from West Australia. Some of the exhibits were abnormally large; a specimen of *Hymenolepis diminuta* from *Mus decumanus* reaching over 3 feet 9 inches in length, the normal size being 8-24 inches; *Gigantorhynchus moniliformis* about 8 inches long (ordinarily about 3-4 inches); *Anoplocephala plicata* nearly 15 inches long (ordinarily about 2-3 inches).

Mr. E. J. Goddard, who had recently had the opportunity of assisting Mr. James Murray, Biologist to the British Antarctic Expedition, 1907, to collect *Tardigrada* and Bdelloid *Rotifera*, described the method of obtaining these organisms. Mosses and Hepatics, which form their natural resort, are collected and washed under a rapid tap-stream, in a net of coarse bolting cloth placed inside a net of finer mesh. It is found that Rotifera are washed into the finer net and safely held. In this way Mr. Murray was enabled to obtain species of both groups, many new to science, and many of special interest from the standpoint of distribution. Mr. Goddard also pointed out the opportunity of doing good work awaiting a biologist who would take up the study of these groups in earnest.

Mr. Fletcher, on behalf of Mr. H. Wasteneys, of Brisbane, showed two examples of short pieces of wood, more or less pointed at both ends, cemented to the branches of shrubs, met with on the Enoggera water-reserve; and he asked for an explanation of their occurrence. The only suggestion forthcoming was one offered by Mr. Jardine, that the phenomenon was attributable to flood-action.

METASOMATIC PROCESSES IN A CASSITERITE VEIN FROM NEW ENGLAND.

By Leo A. Cotton, B.A., B.Sc., Junior Demonstrator in Geology, University of Sydney.

(Plates xviii.-xx.)

The chief workers on the origin and occurrence of tin in New England are Professor David, B.A., F.R.S., and Mr. E. C. Andrews, B.A. The former worked chiefly in the Emmaville District, and made the relations of the Tertiary basalts to the deep leads his main investigation.* Since Professor David's work was published, mining enterprise has caused more attention to be paid to lode-tin mining. Mr. Andrews, as a later worker, has consequently paid somewhat more attention to this phase of the subject. In his papers on the geology of New England† he has dealt at some length with the igneous formations. The granites, which occupy the largest portion of New England, he has grouped into three classes—(1) The "blue granite." (2) The "sphene-bearing granite." (3) And the "acid granite." Of these it is the "acid granite" with which the cassiterite veins of New England appear to be associated.

Mr. Andrews considers that these veins are the result of intruding solutions, of a very acid nature, into the acid granite. From his observations on the minerals developed in these veins, and their resemblances to foreign occurrences, he has expressed his opinion that the processes involved are chiefly of a metasomatic nature.

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* Geology of the Vegetable Creek Tin-mining Field. Mem. Geol Survey N. S. Wales. Geology No.1(1887).

† "The Geology of the New England Plateau,with special reference to the Granites of Northern New England." Rec. Geol. Survey N. S. Wales, Vol. viii., pp.108 and 196(1905-07).

With a view to investigating in detail the processes, as compared with the criteria for metasomatism laid down by Lindgren,‡ the following work was undertaken. In June of this year, accompanied by my brother, Mr. M. Cotton, I visited the southern portion of the New England tin-bearing area, and made some observations at Tingha, Howell, Newstead, Gilgai and Elsmore. About a fortnight was spent in field-work, at a spot 6 miles to the south-west of Inverell. Here a number of cassiterite veins were examined.

Among these were the lodes of the Leviathian and Hill Cliff Tin Mines. At the former mine, the lode consists of a number of somewhat irregularly disposed veins, having a general north and south direction. To the west of this lode are a number of smaller veins, having the same general direction. One of these was selected for the purposes of analysis and microscopic investigation. This vein was one of the smaller ones, being about 10 to 11 inches wide where the sample was selected. Towards the northern end there seemed to be, as far as could be determined by hand-specimens, a progressive increase in molybdenite. Towards the southern end the vein became much more irregular, and exhibited a progressive increase in cassiterite. The molybdenite occurs in small flakes up to 2 mm. in diameter, and the cassiterite in grains and crystals of similar dimensions.

The vein at the north end is fairly regular in width, but widens greatly at the south end, where it becomes some 3-4 feet in width, with no well defined walls. A few crosscuts have been made at this end, but the cassiterite-content is too low for economic working under existing conditions. Where the lode is best defined a marked differentiation was observed.

The central portion of the vein is a band of almost pure quartz (see Analysis A, p. 225), varying from 1-3 inches in width. On either side of this band the vein-material gradually merges into the normal granite constituting the country-rock. Where this band attains a maximum thickness, large, well developed crystals of quartz, from 1-2 inches in length, are developed. These crystals

‡ "Metasomatic Processes in Fissure-Veins." Trans. American Inst. Mining Engineers, Vol. xxiv., 1900.

project into cavities. The sample selected for investigation represents a complete transverse section of the vein, showing the change into granite on each side. This sample was cut in halves by a transverse vertical cut. One half is shown in Plate xviii.

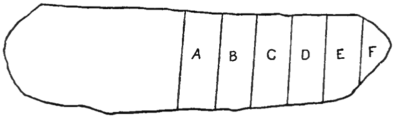

Fig. 1.—Diagrammatic section illustrating how the vein was cut. The sections A, B, C, D and E were each one inch in width. Section F was smaller, and only a small slide was obtained from it.

Text-fig. 1 illustrates how further subdivision was made on the remaining half. The six pieces lettered A, B, C, D, E, and F were formed by cuts, one inch apart. From each of the sections so formed, two slabs were cut. One of these served for making a large section for examination under the microscope; the other, which weighed about 20 grammes or more, was used as a sample for analysis. The slides, which were of large size (about 2 × 1 inches), when examined microscopically, supplied most abundantly all the chief phenomena laid down by Lindgren as evidences of metasomatic replacement. Slide A is from the centre of the vein. Slide G is of the normal granite. The other slides are intermediate and in alphabetical order. A description of the slides is as follows.

Slide A.—This section is almost entirely composed of quartz. A little secondary hæmatite is present, filling the fractures in the quartz. Biotite is present in very small amount, and almost invariably shows replacement by a non-ferruginous mica, the composition of which will be discussed later. The primary quartz occurs both as idiomorphic crystals, and as allotriomorphic grains; and contains abundant cavities, in most of which small liquid inclusions are present. These cavities are very small, and can be seen only under the high powers of the microscope. Most of these cavities are irregular in shape, but many of them are negative crystals of quartz. It is not uncommon to find small crystals included within the negative crystals, but, when this is so, the included crystals are too small to be determined. There is a tendency for these crystal-cavities to be arranged in planes parallel to that of the vein. Several cavities and negative crystals are shown in Plate xix., fig.1. Topaz is possibly present in very small amount.

Slide B.—This is distinctly more basic than slide A. Mica is more abundant, and excellent examples of replacement of quartz by this mineral are common (see Plate xix., fig.2). Biotite occurs in small amount, almost invariably showing replacement by the non-ferruginous mica. A few crystals and grains of fluorite are present; these are of the colourless variety, and seem to be usually associated with the biotite.

Slide C.—This slide shows a still further decrease in quartz, and a corresponding increase in non-ferruginous mica. As in B, a small amount of biotite is present, showing replacement by the non-ferruginous mica. There is also a noticeable secondary alteration of biotite to hæmatite. Fluorite is more notable than in Slide B, but is present only in small amount (see Plate xix. fig.3). Irregular grains of what is probably molybdenite, occur scattered through the slide.

Slide D.—This section is much the same as C, but there is a still further decrease in quartz, and a corresponding increase in the non-ferruginous mica. Biotite is present in small quantities only; and, as before, shows replacement by the non-ferruginous mica. Fluorite is present in about the same amount as in Slide C, and is mainly associated with biotite. In one instance an idiomorphic crystal of fluorite penetrates a biotite crystal; and, along the line of junction, a development of the non-ferruginous mica occurs; this particular crystal of fluorite is coloured a characteristic violet. A small amount of felspar is present, and two idiomorphic crystals of albite show most perfectly the incipient metasomatic action of the non-ferruginous mica. One of these is represented in Plate xix. fig.4.

Slide E.—One side of this slide inclines towards the normal granite, and the other to the vein-material. There is, however, no definite junction-line between the two extremes. The non-ferruginous mica is present in large amount, possibly slightly in excess of the quartz, which is less abundant than in Slide D. Felspar is present in appreciable amount, showing replacement by non-ferruginous mica, which seems to be the main metasomatic constituent throughout. This replacement of felspar has occurred chiefly, though not wholly, along the cleavage-planes. A little molybdenite, and some secondary hæmatite are present. Cavities are to be seen in the quartz present on the vein-side of the slide, but none are present in the quartz on the granite-side. Thus the presence or absence of cavities serves to distinguish the vein-quartz from that in the country-rock. On the side of the slide approaching the granitic texture, a relic of graphic structure was noted, which was distinct, though modified considerably by the replacement of both the quartz and felspar by mica.

Slide F corresponds with Slide G, save that some of the quartz and felspar show replacement by mica.

Slide G is of the normal granite. It is holocrystalline, the grain-size is variable, and graphic structure is present. Quartz is the most abundant constituent, after which albite and orthoclase are respectively the next most important. The quartz and orthoclase are frequently intergrown, giving rise to graphic structure. (See Plate xx., fig. 1). A little biotite is present, and also some secondary hæmatite. There is no fluorite present; nor is there any sign of the non-ferruginous mica, which is such a characteristic feature of the vein-material.

A series of four analyses was made, which though not quite complete, yet casts much light on the origin of the vein. The analyses A, C, and E are of those portions of the vein represented in text-fig. 1; and analysis G is of the normal granite beyond the sphere of metasomatic action. Analyses E_1 and are G_1 quoted from Lindgren,* the former representing the altered product of metasomatic action in a cassiterite vein from Altenberg and Zinnwald in Saxony, and the latter the normal granite from which this alteration took place. The following are the analyses, lettered to correspond with the text, and with text-fig. 1. The molecular ratios are also given.

* Metasomatic Processes in Fissure-veins.

Constituents.	Analysis A.	Molecular ratios.	Analysis C.	Molecular ratios.	Analysis E.	Molecular ratios.	Analysis G.	Molecular ratios.	Analysis E_1	Molecular ratios.	Analysis G_1	Molecular ratios.
SiO_2	98·11	1·624	78·47	1·298	75·42	1·249	76·69	1·269	70·41	1·166	74·68	1·236
Al_2O_3	0·75	0·007	11·50	0·113	12·98	0·127	10·89	0·107	14·86	0·146	12·73	0·125
Fe_2O_3	0·43	0·003	2·64	0·017	1·66	0·010	0·76	0·005	1·42	0·009	—	—
FeO	—	—	1·05	0·015	0·58	0·007	0·39	0·004	5·09	0·071	3·00	0 040
MgO	none	—	0·49	0·012	0·23	0·006	0·18	0·004	0·09	0·002	0·35	0·008
CaO	none	—	trace	—	0·10	0·002	1·73	0·031	0·21	0·004	0·09	0·002
Na_2O	—	—	1·99	0·032	3·05	0·049	5·35	0·086	0·98	0·015	1·54	0·025
K_2O	—	—	1·17	0·013	1·62	0·017	2·97	0·032	3·01	0·032	4·64	0·048
H_2O+	0·04	0 002	0·23	0·013	0·47	0·027	0·13	0·007	—	—	}	—
H_2O-	0·02	0·001	1·17	0·065	1·31	0·073	0·37	0·021	—	—	} 1·17	0·065
TiO_2	—	—	0·22	0·003	0·15	0·002	—	—	0·49	0·006	0·71	0·011
F	—	—	p.n.d.	—	p.n.d.	—	—	—	3·10	0·163	—	—
CuO	—	—	—	—	—	—	—	—	—	—	0·50	0·006
SnO_2	—	—	0·08	—	0·22	0·001	—	—	0·49	0·003	0·09	0·001
* MoS_2	—	—	0·80	0·005	1·69	0·011	—	—	—	—	—	—
MnO	—	—	—	—	—	—	—	—	0·29	0·004	—	—
Total	99·35	—	99·81	—	99·48	—	99·46	—	100·44	—	99·50	—

* Calculated from S.   p.n.d. = present, not determined.

The chief error in the analyses, arising from impurities in the reagents (the purest obtainable were used), was that in the determination of the alkalies. A blank analysis was made for alkalies, which were found to give rise to an error of 0·31% of K_2O, and 0·13% of Na_2O. The figures given in the table of analyses represent the actual results obtained, less the above corrections for alkalies.

A series of curves has been drawn, after the method of Pirsson, to illustrate graphically the relationships of the analyses.

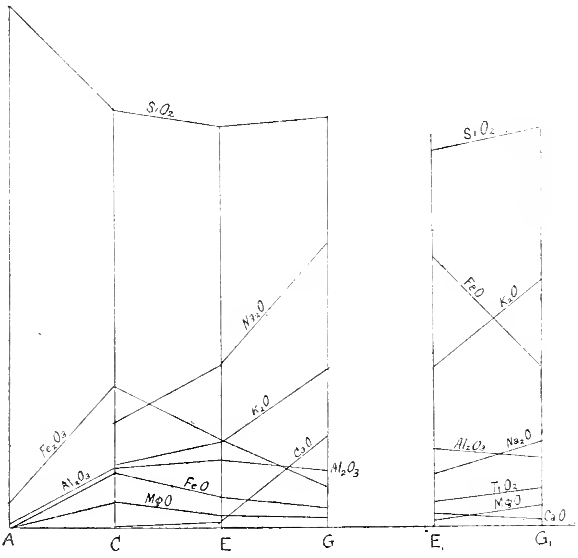

Fig. 2.—Graphical representation of the tabulated analyses.
Abscissæ represent distances apart of the rocks in the field. Ordinates represent the amounts of constituents present.

N.B.—SiO_2 and Al_2O_3 plotted to one-tenth the scale of the other constituents.

From these curves it will be seen that the centre of the vein is highly siliceous, and that there is a decrease in acidity from the centre towards the contact with the country-rock. It is probable that this is, in some measure, due to differentiation in the intruding solution. The curves indicate a minimum SiO_2 percentage in the neighbourhood of the contact of vein-material and country-rock.

From the numerous liquid inclusions present in the quartz of the vein-material, it is evident that the conditions of introduction of the vein-solutions must have been such that the pressure and temperature were above those at the critical point.*

In endeavouring to ascertain the nature of the intruding rock solution several principles seem to me to be necessary. These are:—

(1) Those constituents characteristic of the intruding solution should show a progressive decrease from the centre to the margin. Due allowance must, however, be made for magmatic differentiation within the vein itself.

(2) Those constituents characteristic of the country-rock and not of the vein, should show a decrease from the margin to the centre of the vein.

(3) Those constituents formed by the action of the intruding solution on the country-rock should show a decrease on either side of the zone of maximum metasomatic activity.

(4) Constituents which occur in approximately equal amounts in the primary vein-solution and the country-rock should appear fairly uniformly distributed throughout the whole replacement-vein.

(5) That, besides metasomatic activity *in situ*, evidence of metasomatism with transportation of substance should be sought for.

The processes active in the vein between A and C seem to have been dominated by magmatic differentiation of the intruding pneumatolytic solution. This differentiation appears to have been effective in concentrating the siliceous material chiefly at the centre, and the ferromagnesian constituents towards the margin. Between C and E the ferromagnesian constituents

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* The critical temperature for water is 365° C at a pressure of 200 atmospheres.

decrease; and this would indicate that the width of the fissure, along which the solution ascended, could not have extended much beyond C. This would indicate a width of about 3 inches for the original fissure. Between C and E the curves indicate an increasing amount of alkalies and lime from the vein to the country-rock. Alumina seems to be fairly uniformly distributed between C and G, being somewhat more abundant towards C. This would indicate that the ferromagnesian product of the differentiation of the vein-material contained more alumina than the country-rock.

From the foregoing it would appear that the primary constituents of the intruding solution were SiO_2, FeO, F, SnO_2, MoS_2, Fe_2O_3 and possibly Al_2O_3 and MgO. The other constituents of the vein, as analysed, were probably almost wholly derived from the country-rock. The chief of these are CaO, Na_2O, K_2O, and possibly TiO_2.

A comparison of E_1 and G_1 with E and G shows that these deductions are in harmony with those made by Dr. Dalmer on Analyses E_1 and G_1. With regard to the alteration in the country-rock G_1 caused by the metasomatic action yielding the product E_1; Lindgren states that "Dr. Dalmer concludes that the principal changes consisted in the addition of FeO, F, SnO_2 and possibly Al_2O_3, while K_2O, Na_2O, and SiO_2 have been subtracted. In the absence of further knowledge of the relations of volume during the alteration, it is scarcely possible to conclude, from the comparison of these analyses alone, what the actual changes have been."

In attempting to trace the actual metasomatic changes, I was soon convinced that though, with my present data, the problem was an indeterminate one, yet the following generalisations seemed to be justified.

The resulting product of metasomatism has given rise to a non-ferruginous mica, to fluorite and possibly topaz. The nature of the mica, which is the characteristic replacing constituent, is an indeterminate problem. It depends on the amount of secondary hæmatite present; and also on the composition of the biotite, which is itself unknown. However, it seems fairly certain that this mica was formed, in great part, by the replacement of the felspars, so that the alkali-molecules were retained in the new product. The composition of the mica seems to be a mixture of paragonite and sericite molecules, with replacement of some of the H_2O molecules by Na_2O. Its general composition may be written 3 (K, H, Na)$_2$ O, 3 Al_2O_3, 6 SiO_2. It is possible that some Li is also present, as this was not sought in the analyses. It is also more than probable that some F enters into the composition of this mica.

Criteria of Metasomatism.—If the results discussed above be judged by the criteria for metasomatism given by Lindgren, it will be seen, I think, that the evidence for such action is complete. Lindgren *(op. cit.)* states the following.

(1) "The only decisive criterion is that of metasomatic pseudomorphism involving the proof (generally to be furnished by microscope study) as to whether simultaneous dissolution and deposition have actually taken place. The most satisfactory proof is the distinct alteration of well defined crystals (or, at least, well defined grains) of the original mineral into the secondary mineral in such a way that the latter projects into the former in prisms or fibres having crystalline outlines."

(2) "Another proof is afforded by sharply defined crystals of the secondary embedded in the primary mineral, without any break between their surfaces; but in this case it must be clear that the mineral is really secondary and was not formed before the primary."

(3) "The occurrence of *nuclei* of unaltered rock is sometimes an available criterion, but it must be used with caution; and probably has given rise to misinterpretations, on account of its similarity to actual inclusions of country rock in vein-filling."

(4) "Generally . . . . the replacement proceeds very irregularly, owing to the effect of little cracks and fissures."

In quoting the above, I have taken the liberty of numbering the paragraphs for reference. The alteration of quartz into the characteristic mica is a good illustration of No. 1. Plate xx., fig. 2, shows this. This alteration is abundant in Slides B, C, D and E.

An excellent example of No.2 is given in Plate xix., fig.4, which illustrates the albite crystal described from Slide D. Complete crystals of mica are present in the felspar without discontinuity of their surfaces.

Plate xx., fig.3, illustrates No.3. Here biotite has been replaced by the paragonite-sericite mica, and several pieces of the former are completely surrounded by the latter. Almost any random section will serve to illustrate how the replacement has taken place along cracks and fissures, thus illustrating No.4. An example of this is afforded by Plate xx., fig.4.

Mr. Emmonds has suggested the following field-structures as necessary criteria—

(1) "Absence of symmetrical banding or comb-structures in the vein-material, and of breccias of country-rock cemented by vein-material."

(2) "Great irregularity in width of the ore-bodies, which may reach very great dimensions."

(3) "General lack of definition between ore-body and wall-rock."

Though, in the microscopical examination, it was noted that the cavities in the primary vein-quartz had a tendency to arrangement in planes parallel to the fissure-plane, yet in no sense could it be said that symmetrical banding was present. Field-observations failed to detect either the slightest trace of such banding, or of breccias of country-rock included in vein-material.

The irregularity in width of the vein examined has been already mentioned. The fact that there is a progressive change from ore-body into country-rock shows that there is a lack of definition between the two. Thus the chain of evidence for metasomatism seems complete.

Summary—A sample constituting a complete transverse section of a cassiterite vein from near Inverell in New England was selected for examination. The object was to investigate the processes involved in the formation of such veins, these processes having been generally described as being of a metasomatic

nature, by Mr. E. C. Andrews, B.A., in his work on "The Geology of the New England Plateau."

A series of slides, covering the entire distance from the centre of the vein to the country-rock, was examined, and a series of four analyses, three of the vein-material and one of the country-rock, were undertaken. The former, when judged by the criteria for metasomatism suggested by Lindgren, were found to give abundant evidence of such action. The analyses were used to deduce the processes which were dominant in the formation of the vein. A diagram of the analyses, after the method of Pirsson, was constructed to show the relations graphically. Two analyses used by Dr. Dalmer in a similar, but less detailed examination, were included for comparison. From the variation in the analyses it is probable that the fissure, along which the solutions rose, was not more than 3 inches in width, and that the total width of about 10 inches is due to metasomatic replacement of the country-rock. The constituents of the solution, which was probably under pneumatolytic conditions, were found to be chiefly SiO_2, FeO, MgO, SnO_2, MoS_2, and Al_2O_3. These acted on the country-rock, which is a granite; and, by molecular replacement, formed a vein-product containing the above-mentioned constituents, plus CaO, Na_2O, K_2O, and TiO_2, probably derived from the granite. The characteristic metasomatic product is a paragonite-sericite mica, with Na_2O replacing some of the H_2O molecules. The exact composition of this mica is indeterminate, and it quite probably contains fluorine. A second metasomatic product is fluorite, probably formed by the action of the fluorine-bearing solution on lime-felspars in the country-rock.

Finally, a comparison of the analyses and deductions with those made by Dr. Dalmer in his work on the tin-deposits of Altenberg and Zinnwald in Saxony, gave quite harmonious results.

In conclusion, I would like to express here my thanks to Dr. W. G. Woolnough, F.G.S., Acting Professor of Geology at the University of Sydney, for the kindly interest he has taken in this work, for his ever-ready help, and for the unstinted

manner in which he has placed every facility at my disposal in the carrying out of this investigation.

EXPLANATION OF PLATES XVIII.-XX.

Plate xviii.

Section across the fissure-vein, showing normal granite on each side, and vein-material between.

Plate xix.

Fig. 1.—Section showing cavities, and negative crystals in vein-filling; ($\times 70$).

Fig. 2.—Quartz showing replacement by non-ferruginous mica. Crossed nicols; ($\times 20$).

Fig. 3.—Showing fluorite in centre, and biotite replaced by non-ferruginous mica; ($\times 20$).

Fig. 4.—Albite crystal, showing replacement by non-ferruginous mica; ($\times 20$).

Plate xx.

Fig. 1.—The normal granite, with graphic structure. Crossed nicols; ($\times 20$)

Fig. 2.—Replacement of quartz by non-ferruginous mica; ($\times 20$).

Fig. 3.—Biotite, with replacement by non-ferruginous mica; ($\times 20$).

Fig. 4.—Quartz, showing replacement by non-ferruginous mica along cracks; ($\times 20$).

NOTE ON THE GUYRA LAGOON, N.S.W.

By Leo A. Cotton, B.A., B.Sc., Junior Demonstrator in Geology, University of Sydney.

(Plate xxi.)

While passing through Guyra on his road to Inverell, the writer was struck by the appearance of what is known locally as the "Mother of Ducks Lagoon." From the history, as obtained from local information, and from its physiographical aspect, the lagoon promised to be of some scientific interest; and the following note embodies the observations made in June last by the writer and his brother, Mr. M. Cotton.

Geographical.—The Guyra, or Mother of Ducks Lagoon, lies beside, and to the west of, the Sydney to Brisbane railway line, about 27 miles north of Armidale. It is oval in shape, the longer diameter being about north and south. The greatest length is 2 miles, and the greatest breadth about 1¼ miles. The town of Guyra lies on the north-eastern shore of the lake, and has an elevation of 4,330 feet above sea-level. With the exception of Black Mountain, which has the same height, and Ben Lomond, which is 143 feet higher, Guyra is the highest town on the New England railway line. At Black Mountain, however, the surrounding country is considerably higher than the railway station; while at Guyra there is a difference in level of only a few feet between the railway station and the highest point of the adjacent country.

The lagoon, when examined, was found to be hemmed in on all sides by a basalt ridge of varying height. This ridge, on the eastern side, rises about 50 feet above the bed of the lake; while, on the northern and western sides, the height is about 60 and 70 feet respectively. On the south side of the lake the ridge is much lower, rising only to about 20 or 30 feet At the extreme south-east corner the ground rises only a few feet above what was once the normal water-level of the lake. This breach in the basalt-ring surrounding the lake appears to be the only inlet. Through this inlet flows the water from the direction of Black Mountain, so that the catchment area of the lake is of very small

Fig. 1.—Map of the Guyra Lagoon, showing (i.) the drainage-system; and (ii.) the inner crater at A.

extent. The total length of the catchment area is probably only 3 or 4 miles, and its breadth rather less than 2 miles. The hills surrounding the lake are well timbered, and slope at about 15° to 20° towards the lake-bed. The old water-level in the lake is well marked, indicating the stability of the lake for a considerable time. Nowhere could the water have exceeded a depth of 10 feet. Within the lake, at its south-western extremity, is a crescentic ridge of basalt parallel to the shore-line. This ridge gives rise to several small islands when the lake is full (see text-fig. 1).

Geological.—The district for some miles round Guyra consists of a basalt-formation. This was observed to extend for some 8 miles to the south, and 5 miles to the west. The basalt noticed at Black Mountain contains phenocrysts of olivine, while in that of Guyra no such crystals were observed. This may indicate a different origin for the two lavas mentioned. A few miles to the south of Black Mountain, on the Armidale Road, the basalts were observed to overlie unconformably a series of Palæozoic sediments consisting of quartzite, slate, and conglomerate. From aneroid measurements it appears that the basalt here attains a thickness of at least 1000 feet. These sediments were seen to be intruded by granite, a few miles to the south of their junction with the basalt.

On the western side of the lagoon, a series of altered sediments was found, at a distance of 6 miles from Guyra; while, at a distance of 7½ miles in the same direction, a very striking porphyry was met with. This rock contains phenocrysts of orthoclase and quartz, the former being so abundant as to give a pink color to the rock. It was also observed some 20 miles north of this spot.

Fig.2 of Plate xxi., shows a diagrammatic section from north-west to south-east, through the Guyra Lagoon.

At the time when the writer visited the lagoon, the bed was being used as pasture land. Local residents state that no considerable amount of water has been present since 1902, but that previous to that year the lagoon was never known to be dry. Since 1902, small bodies of water have accumulated after heavy rains, but have quickly disappeared. So little does this basin now function as a lake, that a well sunk to a depth of 35 feet in the lake-bed failed to reach water. Locally it is commonly believed that the lake has been exhausted by the drain made upon the artesian waters in the western areas. The geological structure of the district scarcely admits of such an explanation. An obvious possible cause is a diminution in the rainfall; and with a view of ascertaining whether this afforded any explanation, the record of the rainfall of Guyra for the past

20 years was obtained from the Meteorological Bureau. The figures are given below :—

Year.		Rainfall in inches.		Year.		Rainfall in inches.
1886	..	37·72	...	1897	...	29·40
1887	...	42·53	...	1898	...	23·01
1888	...	22·85	...	1899	...	28·27
1889	...	41·55	...	1900	...	34·79
1890	...	55·44	..	1901	...	32·95
1891	...	45·52	...	1902	...	26·91
1892	...	14·11*	...	1903	...	40·71
1893	...	—	...	1904	...	32·29
1894	...	—	...	1905	...	36·08
1895	...	7·74*	...	1906	...	30·73
1896	...	34·52	...	1907	...	38·25

According to these figures, it will be seen that the rainfall has been quite normal since 1902.

It is also possible that earth-movements have opened fissures through which the water may have drained to lower levels. Mr. Frank Cotton has stated that the country in the immediate neighbourhood has only recently been used for cultivation, having previously been utilised for pastoral purposes. He suggests that the difference in the run-off from the hard pastoral ground, and the soft absorbent cultivated land may account for the failure of water to reach the lake. The question is one of some moment to the Lands Department, by which the lake-bed was proclaimed a temporary common in 1904. Applications are now being made to use it for agricultural purposes.

Summary.—From the evidence so far gathered, it appears that the Mother of Ducks Lagoon is an old crater-lake. The chief evidences in favor of this hypothesis are—

(1) The lake occurs in a rock of volcanic origin.

(2) The limited drainage-area, which is restricted by a continuous hill some 40-50 feet high round the lake. [The inlet at the southern end of the lake may be regarded as a breach in the old crater-ring.]

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* Incomplete returns.

(3) The considerable depth of alluvial in the lake, probably representing a filling-up of the crater.

(4) The inner ridge at the south-west of the lake, which probably is a remnant of an inner crater so common in volcanoes.

(5) The great height of the lagoon, from which the land falls away in all directions (See Pl. xxi., fig.2), save immediately to the south. This rise to the south is due to the more active source of eruption at Black Mountain.

Conclusion.—In view of the evidence above given, it seems probable that many other mountain-lakes in this district, situated at high levels, such as the Ben Lomond Lagoon, are of similar origin. The identification of these lakes as centres of volcanic eruption, will be useful in solving such problems as the sequence of the lava-flows, the periods of maximum and minimum volcanic activity, and the location of deep leads.

EXPLANATION OF PLATE XXI.

Fig.1.—Guyra Lagoon, looking towards the east. The rising ground near the central part of the photo is the inner crater shown as A in text-fig.1.

Fig.2.—Section through the Guyra Lagoon from north-west to south-east, showing the geological structure of the district.

ON SOME RARE AUSTRALIAN GOMPHINÆ, WITH DESCRIPTIONS OF NEW SPECIES.

By R. J. Tillyard, M.A., F.E.S.

(Plates xxii.-xxiii.)

The present paper is an attempt to collect together and bring up to date all the facts which have come to light concerning Australian *Gomphinæ* since the publication by me, in 1905, of descriptions of three new species, *Austrogomphus arbustorum, A. arenarius,* and *A. prasinus.*

Owing to their restricted distribution and seasonal range, the members of the genus *Austrogomphus* are not easily studied by anyone unable to visit many new localities at different periods of the year. Though in temperate climates these insects are restricted to a brief range of about two months, December and January, yet in tropical Queensland this is not the case. A locality may be visited in December, and yield several species; on a second visit, made in April or May, all those species found in December will be absent, and other new species will have taken their place. Whether any of these species have a long seasonal range, can only be determined by continuous collecting in the same locality throughout the year; at present, it is generally believed that no single species of the subfamily *Gomphinæ*, either in tropical or temperate climates, has a seasonal range of more than three or four months at the outside.

Besides this fact, the peculiar habits of these insects render them difficult to obtain even in the most favourable localities. One day they may be found abundantly in a particular spot; but a visit to the same place on an equally favourable day shortly afterwards may result in complete failure. Some species, whose larvæ swarm in the mountain creeks, are seldom seen on the wing; and what becomes of the thousands of imagoes that must certainly breed out from these larvæ, still remains a matter for conjecture.

Bearing these facts in mind, we may confidently expect that new species will continue to be found in all parts of Australia for many years to come; nor is it likely that we shall reach a complete knowledge of this genus until more workers in many localities are induced to study these insects.

De Selys described in his four works on the *Gomphinæ* (Synopsis des Gomphines, 1854; Additions, 1859; Seconde et 3me Additions, 1869, 1873) ten species of the grand genus *Gomphus* from Australia. For the reception of these he proposed the subgenera *Austrogomphus* and *Hemigomphus*, relegating one species only to the Old-World subgenus *Onychogomphus*, viz., *O. praeruptus.* The two former subgenera were, however, purely artificial, and in 1901, M. René Martin placed all ten species in the single genus *Austrogomphus*, and added two new species from Queensland. It seems best to keep to this arrangement for the present, until a careful study of both larval and imaginal forms may reveal some distinct lines of separation. As regards wing-venation, all the species are practically alike. Very little variation in this respect can be found throughout the whole subfamily, and this makes the work of subdivision very difficult. Natural selection seems to have mainly busied itself, in this subfamily, with providing each distinct form with appendages differing widely from those of its nearest allies. In this we see a wise provision for the preservation of the species; for amongst insects so seldom on the wing and so widely scattered, every chance meeting of a male and female must be made use of; the capture of the latter by the former must be swift and certain; and to this end, specialization has proceeded to great lengths in the form of the male abdominal appendages; and also, as a complementary result, in the structure of the occiput of the female, which becomes modified to suit the grasp of the male.

Throughout the subfamily protective colouration is found. Corresponding to their forest habitat, we find a general scheme of colouration, in which the markings are always some shade of green or yellow on a black or dark brown ground. In the genus *Austrogomphus* the thoracic markings in particular are of great value in determining species, very little individual variation being found. By referring to Plate xxii., fig. 11, the whole scheme of thoracic markings may be readily understood. The figure is diagrammatic, and represents the whole of the thorax, except the prothorax, flattened out. Both sides of the upper surface or mesepisternum (*A*) are shown; the whole being crossed longitudinally by the mid-dorsal ridge or carina (*h*) ending in the cross-suture called the interalar ridge (*e*). Besides this, on each side, well forward, is a slanting transverse suture, the two together forming the mesothoracic collar, or half-collar (*g*). On the mesepisternum we have the following scheme of markings:—*a*, the border mark, next the prothorax; *b*, the half-collar mark; *c*, the dorsal stripe or band; *d*, the antehumeral stripe or band; and *e*, the mid-dorsal line. In many species, *b* and *c* coalesce, forming a more or less perfect representation of a figure "7"; the two together may then be called the "seven-mark." Also the antehumeral stripe, which is always narrow, is in some species broken up into a fine line followed by a round or triangular spot. Coming now to the side of the thorax, *i.e.*, that portion lying below the humeral suture (*i*), we have the large areas, separated by parallel sutures called the upper or first lateral suture (*j*) and the lower or second lateral suture (*k*); these are the mesepimeron (*B*), metepisternum (*C*), and metepimeron (*D*); there is also a small piece in front, near the coxa, called the mesinfraepisternum (*E*). Generally, over the whole of this portion of the thorax the paler colour predominates, with more or less regular dark lines or bands following the sutures. But in some species these bands are very broad, and coalesce, isolating large oval yellow spots. The complete thoracic scheme alone is generally sufficient to determine the species to which any specimen of *Austrogomphus* belongs.

For further specific differences, recourse must be had to sexual characters. The abdominal characters of the males are so diverse and peculiar that it is generally easy to determine them. The females are more difficult to separate; but in any cases where the thoracic scheme is not sufficiently different between two species (as in *A. collaris* and *A. australis*) the form of the occiput will determine the species.

During the spring of 1908, I was able to collect and to breed out the larvæ of four species of *Austrogomphus* occurring near Sydney. An account of these is reserved for another paper, it being only necessary to say here that a study of the larvæ will probably enable us to subdivide our large and increasing genus into two, or possibly three, homogeneous groups, differing in important respects both in habit and structure.

Of the new species described in this paper, one was taken by me first in 1907, on Duck Creek, near Sydney, and appears to be firmly established there, though never common. Another I obtained during my visit to Cooktown in January, 1908. My friend, Mr. Allen, of Cairns, took a very remarkable new species at Atherton, N.Q., in April, 1907, and at the same time found the rare *Austrogomphus Risi* Martin, of which the female alone was known. Mr. F. P. Dodd, of Kuranda, is the discoverer of another unique male, which I have dedicated to him. Descriptions of these species, together with some notes on other rare species, are given below.

1. Austrogomphus melaleucæ, n.sp.

♂. Total length 43 mm.; abdomen 32 mm.; forewing 26 mm., hindwing 25 mm.

Wings:—*neuration* black. *Pterostigma* broad, convex, black, 2·7 mm. *Membranule* nil. *Nodal Indicator* | 11-13 7-10 | 8-9 6-9 |

Head: *eyes* black, a large round yellow spot underneath on the orbits, a smaller spot close to it, in front; *occipital ridge* 0·6 mm., yellow; *vertex* black; *ocelli* black, collinear, on three equal tubercles; *antennæ* black, basal joint thickened, a yellow half-circle at bases; *front* rather large, bright yellow, slightly cleft medially; *postclypeus* jet black; *anteclypeus* pale yellow or cream-coloured; *labrum* same colour, crossed in the middle by a broad black vertical bar; *labium* pale dull cream or straw-colour; *genæ* cream-coloured; *mouth* thickly edged with black or dark brown. Thorax: *prothorax* black; a yellow spot on neck; behind this an elongated yellow spot on collar; a tiny double yellow spot in the middle, and a single small spot behind next mesothorax. *Meso-* and *metathorax* black marked as follows with bright lemon-yellow :—on the mesepisternum, a small border mark, a short thin mid-dorsal line; a pair of very conspicuous "seven-marks," in which the head is short, thick, and blunt, and the tail rather broad and not much pointed; the antehumeral band is represented by a short fine line, with a large roundish spot at some distance behind; in some specimens the spot only is present. Sides of thorax shiny black, isolating two large oval yellow spots, one mainly in *C*, but with the upper part in *B*, and the other low down on *D* close to abdomen; besides these, a yellow mark on *E*, a small spot on *C* near wings; a small round spot on *D*, close under the wing-joins, and a larger round spot on *D*, in front (see Plate xxii., fig.1); *notum* black, *scuta* and *scutella* bright yellow. *Legs* black, underside of profemora with a yellow stripe, coxæ pale cream-coloured. Abdomen: 1-2 swollen, 7-10 strongly clubbed. Colour black, marked as follows: 1, a large transverse dorsal yellow spot; 2, auricles large, bright yellow; behind them an anal lateral yellow mark; 2-6, a yellow dorsal line, widest on 2, reaching nearly the whole length of segments 2-4, but only about two-thirds of 5, and barely half of 6; each of these segments is marked low down on each side by a pale yellow streak, enlarged at base into a basal sublateral spot, and running alongside the ventral carina, which is black; 7, first three-fifths bright yellow, crossed about 1 mm. from base by a fine black line about 1 mm. long; rest of 7 black, with a small anal lateral spot on each side; 8, an irregular yellowish basal sublateral mark on each side, and an anal lateral yellowish spot, somewhat triangular; 9, black, suture slightly touched with yellow; 10, black. Below, 8 extends downwards on each side in a large curved plate or sheath. Appendages: *superior*, 1 mm., very divergent, cornute, slightly hairy, bases broad and separated; colour bright yellow; each carries underneath an inner lobe or projection, thinner, curved downwards and inwards, black; the tips of these two lobes are fairly close together. *Inferior* strongly bifurcated, the two portions wide apart, 0·6 mm., thick, blunt, upcurved, black, downy (see Plate xxiii., figs.9 and 10; in fig.9 the abdomen was slightly turned up to show all parts).

♀. Total length 48 mm., abdomen 34 mm.; forewing 28 mm., hindwing 27 mm. It differs from the male as follows: *Pterostigma* 3 mm.; very often a tinge of yellow on wings from base up to nodus. *Occiput* with two small yellow tubercles in centre at back of ridge, tips black (see Plate xxii., fig.9). Abdomen: 1-2 swollen, not cylindrical, thicker than in male, 7-10 somewhat enlarged when seen sideways. Markings more conspicuous; 3-6 with the basal sublateral yellow spot large, triangular, and separated from the yellowish edging of the ventral carina; 7 with a small round anal yellow spot on each side; 10 ending below in a dark brownish tubercle, slightly hairy; a smaller round tubercle above it, between appendages. Appendages: 0·9 mm., wide apart, subconical, light yellow, tips black.

This species is very close to *A. praeruptus* Selys, described from a unique specimen (♀) from Adelaide. The latter is a larger species, abdomen 38 mm., hindwing 28·5 mm.; it differs from *A. melaleucæ* in having "three yellow points on the nasus and front" and in the occiput carrying "two small black points, close together." I have not seen the type of *A. praeruptus*, which is in the de Selys Collection at Brussels, but I sent specimens of *A. melaleucæ* to M. René Martin, who considers them a distinct new species.

Hab.—Duck Creek, Auburn, near Sydney, N.S.W. Rare; December-February.

This beautiful Gomphine differs from all others I have seen in the richness of its yellow colouring, which is a brilliant lemon-colour. In that respect it resembles *Synthemis regina* Selys, which accompanies it in the bush near Duck Creek. Probably the same causes have operated on these two species to bring about the same colouration. It is also the only Gomphine known to me which inhabits a sluggish stream. All the others prefer clear mountain streams.

Apparently this species disappears into the bush soon after emergence. One day, at the end of January, 1908, I took five or six males flying up and down the creek, but I have never seen them there since. All the other specimens I have, were taken, one or two at a time, in the teatree bush fringing the creek. The insect is very fond of sitting perched high up on a sprig of teatree, sometimes beyond reach of the net. If disturbed, it flies off with bewildering swiftness and settles on another bush. I have named it *A. melaleucæ* because of this habit. It is not at all easy to capture. The females are very rare, and I have never seen a pair in cop.

2. Austrogomphus bifurcatus, n.sp.

♂. Total length 43 mm.; abdomen 32 mm.; forewing 26 mm., hindwing 25 mm.

W i n g s : *neuration* black. *Pterostigma* 3 mm., black, not very broad, nearly straight below. *Membranule* almost nil. *Nodal Indicator*

13-14	8-9
10	9-10

H e a d : *eyes* brown; *occipital ridge* nearly 1 mm., black, hairy; *vertex* black; front *ocellus* transparent; *front* black, with a rather narrow yellow band along frontal ridge; *postclypeus* black, hairy, a small yellow area on each side next the *anteclypeus*, which is yellow; *labrum* black, *genæ* yellow; *labium* pale straw-colour, *mouth* edged with dark brown. T h o r a x : *prothorax* rather broad, black, a yellow spot in front, and a small yellow central double spot. *Meso-* and *metathorax* jet black above, the markings of the mesepisternum as follows: no border mark, no mid-dorsal line, interalar ridge yellow, half-collar and dorsal stripe combined to form a "seven-mark" on each side, the head being a fairly long oval, rather pointed, to which the tail is attached more than half-way from the upper angle; the tail itself is rather narrow and pointed; antehumeral stripe narrow, ending near wings in a subtriangular enlarged spot. On the sides the colour is yellow, but the black groundcolour from above intrudes beyond the humeral suture so as to cover the most of *B* and half of *E*; the part of *C* and *D* close under the wing-join is irregularly marked with black, especially along the sutures, and the spiracle carries a small black spot (see Plate xxii., fig.2); *notum* black, *scuta* and *scutella* yellow. *Legs* black, underside of profemora yellow, coxæ pale brownish. Abdomen: 1-2 enlarged, 3-7 very slender, 8-10 enlarged. Colour jet black; 1-2, a large yellow dorsal mark, also yellow on sides and auricles; 3-6, on each side a basal subtriangular yellow spot; 7, a pair of larger spots, close together, about 1 mm. from base; 8-10, without spot. Appendages: *superior* very remarkable; 1·6 mm., bases separated, straight, cylindrical, jet black, hairy, *strongly bifurcated*; the outer fork being the longer, fairly pointed, the inner somewhat shorter, very pointed. *Inferior* bifurcated, the two parts widely separated, 0·5 mm., very thin, hooked or curved upwards, black (see Plate xxiii., figs.7 and 8).

♀. Unknown.

Hab.—Atherton, N.Q. Very rare; April.

Two males of this remarkable insect were taken by my friend, Mr. E. Allen, of Cairns, in April, 1907. It probably only emerges after the heavy monsoonal rains of February and March. It was certainly absent during my visit to Atherton in January, 1905.

This species cannot possibly be confounded with any other known species, its remarkable appendages being totally unlike anything hitherto found in the subfamily *Gomphinæ*. Probably its nearest ally is *A. prasinus* Tillyard, in which the appendages have a small bifurcation.

3. Austrogomphus comitatus, n.sp.

♂. Total length 42 mm.; abdomen 31 mm.; forewing 25 mm., hindwing 24 mm.

Wings: *neuration* black, costa slightly yellowish outwards; base lightly suffused with pale yellow for 4-6 mm. *Pterostigma* thick, 2·5 mm., dark brown between black nervures. *Anal angle* 3-celled. *Nodal Indicator*

13	9-10
9	8-9

H e a d : *eyes* dark brown; *occipital ridge* 1mm., black with a large squarish greenish-yellow spot; *vertex* black, *ocelli* prominent, the two lateral ones raised on tubercles; *antennæ* black, with a pale ring at bases; *front* with a greenish-yellow band above, a thick black band on face; *clypeus* greenish-yellow with a thick black band; *labrum* with a large black subtriangular centre surrounded by a yellowish border; *labium* dull dirty brown edged with yellowish. T h o r a x : *prothorax* black, a small double dorsal spot and a pair of lateral spots, greenish. *Meso-* and *metathorax* black above, the mesepisternum marked as follows: a greenish border-mark, an elongated half-collar mark on each side; dorsal band shortened to an elongated oval mark, the upper end of which is some distance from the half-collar, so that no "seven-mark" is formed; antehumeral stripe narrow, slightly curved, ending in an enlarged subtriangular spot near wing-joins; all these marks rich green. Sides of thorax greenish-yellow, with two triangular subparallel narrow black bands along the sutures; the upper one narrowed in the middle and extending in a sharp point downwards in front, the lower very narrow but less irregular; *E*, black with a yellow stripe (see Plate xxii., fig.3); *notum* black, *scuta* and *scutella* yellowish; *underside* dull yellowish, with two cloudy black spots. *Legs* thick, black, underside of profemora with a yellowish stripe. A b d o m e n : 1-2 swollen, 3-7 very narrow, 8-10 sharply clubbed, 8-9 broadly sheathed below. Colour black marked with yellow as follows: 1-2, a longitudinal dorsal band, sides and auricles largely yellow; 3, a narrow transverse basal band, formed by two roundish spots touching dorsally; a small round central spot; 4-7, a narrow basal band; 8, a round basal spot on each side, sheaths edged with yellow, and carrying a tiny tuft of hairs; a fine transverse anal line; 9, a suspicion of a fine transverse anal line; sheaths touched with yellow; underside of 9 dull yellow; 10, broad, black. A p p e n d a g e s : *superior* very wide apart at bases, converging towards tips; 2 mm., thick, strong, somewhat hairy, subcylindrical, broad and blunt at tips; flattened slightly on the inside just before tips, and then hooked or curved inwards into a small rounded projection; basal three-sevenths black, rest yellow, tips just touched with black. *Inferior* black, bifurcated, the two branches wide apart, 1·2 mm., rather slender, black, tips turned upwards suddenly into a sharp point (see Plate xxiii., figs. 1 and 2).

♀. Total length 43 mm., abdomen 32 mm.; forewing 28 mm., hindwing 27 mm.

It differs from the male as follows. *Pterostigma* 3·2 mm. Head: *front* and *clypeus* distinctly hairy on each side; the broad frontal band connected behind by a fine black median stem to the vertex; *occiput* with a very strong black central spine or elongated tubercle (see Plate xxii., fig. 10). Abdomen: stouter and more cylindrical, 1-2 and 8-10 very slightly enlarged: 1, yellow above; 2, a thin yellow dorsal line, sides yellow; 3, with a pair of basal lateral rounded yellow spots and a pair of narrow oval central yellow spots, two-fifths from base of segment; 4-5, with large basal yellow spots on each side, and also a tiny mark on each side, two-fifths from base of segment; 6-7, large basal yellow spots on each side; 8, with small double basal yellow spots low down on each side; 9-10, black, sutures touched with yellow; sheaths of 8-9 touched with yellow; vulvar scale with two short black bifurcations, separated. Appendages: separate, straight, 1 mm., subconical, not very sharply pointed, somewhat hairy, bright yellow, a black spot at base.

Hab.—Cooktown, N.Q. Rare; January, 1908.

I found it only in a secluded spot at the back of Mount Cook, where it inhabits a small mountain brook. It flies in small clearings in company with *Synthemis Olivei* Tillyard. I took three males and two females in good condition.

This species is closely allied to *A. heteroclitus* Selys, a species which occurs locally in New South Wales and Victoria. It can be distinguished readily from the latter as follows: smaller size, front and face much blacker; dorsal stripes shorter and narrower; sides of thorax with two black bands instead of only one half band as in *A. heteroclitus.* In the latter, too, the notum is much yellower; so are also segments 1-2 of abdomen. The superior appendages of the male resemble those of *A. heteroclitus* in shape, but the latter are entirely yellow, except a small black spot at bases; also the male *A. heteroclitus* carries under segment 7 a large tuft of hairs, which is absent in *A. comitatus*. Finally, in *A. heteroclitus* female, the occiput is more yellow and lacks the sharp spine which *A. comitatus* possesses, carrying instead a row of black hairs.

4. Austrogomphus manifestus, n.sp.

♂. Unknown.

♀. Total length 48 mm., abdomen 36 mm.; forewing 27 mm., hindwing 26 mm.

Wings: *neuration* strong, black. *Pterostigma* 3 mm., thick, black. *Nodal Indicator* ‖ 12-14 9-10 / 9 9 |

Head: *eyes* dark brown; *occipital ridge* black, touched with yellow, but carrying *no tubercle*; *vertex* black, lateral *ocelli* tubercled; *antennæ* black with a basal yellow half-ring; *front* yellow above, the black of the vertex advancing centrally into the yellow; *face* yellow, with a broad black band covering the lower part of front and upper part of postclypeus; rest of *clypeus* yellow; *labrum* yellow, crossed by a vertical bar, and with a basal black band and a black edging in front; *labium* yellowish, *mouth* broadly black. Thorax: *prothorax* black, with a small double dorsal yellow spot. *Meso-* and *metathorax* black above; the mesepisternum marked with yellow as follows: no border-mark, a short yellow dorsal line, interalar ridge yellow, half-collar marks and dorsal stripes combined on each side to form a beautiful "seven-mark" in which both the head and tail are well pointed, and the tail very slightly curved; antehumeral stripe represented by a fine line only about 1 mm. long followed behind by a small triangular spot near wing-joins. On the sides two thick black bands have merged together, isolating a tiny yellow spot on the second lateral suture; a large upper irregular oval patch of bright yellow is isolated between these bands and an upper black band formed by the black upper groundcolour extending downwards past the humeral suture; there is also a large patch on *E*, a large roundish spot well forward on *C*, near coxa, and finally a very large irregular patch of bright yellow occupying most of *D* and lying close to abdomen; *underside* with a large dull black patch (see Plate xxii., fig.4); *notum* black; *scuta* and *scutella* yellow. *Legs* black, a tiny spot on elbow of forelegs, and a bright yellow band on underside of profemora. Abdomen: 1-2 swollen, rest long and rather slender, 7-8 slightly broader, 9-10 narrow, cylindrical. Colour black, marked with yellow as follows: 1-2 with a rather broad dorsal mark pointed anally, sides with large irregular blotches of yellow; 3, a pair of large basal lateral semi-oval spots; 4-6, with smaller basal spots; 7, basal third bright yellow, partly crossed on each side from below by a transverse black line; 8-10, jet black; vulvar scale of 8 with a peculiar prominent projection, 1 mm. long, bifurcated, black, and shaped as shown in the figure (see Plate xxii., fig. 7). Appendages: short, 0·6 mm., bright yellow, straight, conical, pointed, rather close together.

Hab.—Kuranda, N.Q. Very rare; January, 1909. A unique female taken by Mr. E. Allen.

This species is probably nearest to *A. bifurcatus*, of which the female is not known. It cannot be the female of that species, however, as the markings of head, thorax, and abdomen are entirely different. Judging from the slenderness of the abdomen of the female, the male should be exceedingly slender, as is the male of *A. bifurcatus*.

5. Austrogomphus Doddi, n.sp.

♂. Unique. Total length 43 mm., abdomen 32 mm.; forewing 25 mm., hindwing 24 mm.

Wings: *costa* yellowish outwards, rest of *neuration* black *Pterostigma* 3 mm., bicolorous, having a pale creamy centre surrounded with black. *Membranule* almost nil. *Nodal Indicator*

14	9-10
10-11	10

Head: *eyes* brown; *occipital ridge* 0·8 mm., black with a large yellow spot; *vertex* black, with a small round yellow spot behind, enclosed in front by a high ridge or tubercle, outside of which the three *ocelli* are set, nearly in a line; the black colour extends just on to the base of the front; rest of *ront* yellow, except a rather narrow straight black band crossing the face just above the postclypeus; *clypeus*, *labrum*, *labium*, and *genæ* yellow, an indistinct black line in suture between clypeus and labrum; *mouth* edged with dark brown. Thorax: *prothorax* black, a yellow band along the collar in front, a tiny double yellow spot behind, and on each side a small yellow spot. *Meso-* and *metathorax* black above, the mesepisternum marked with yellow as follows: no border-mark, a fine mid-dorsal line about 1 mm. long, slightly forked behind; interalar ridge marked with yellow; the half-collar mark oval, and *just* joined to the dorsal stripe so as to form a "seven-mark," in which the tail joins the head about its middle; antehumeral mark consisting of a fine line *just* joined to a triangular spot near wing-joins; sides bright yellow with an irregular black band along the first lateral suture, and a narrow irregular black line along the second lateral suture; *E*, black; spiracle carrying a black spot (see Plate xxii., fig.5); *notum* black; *scuta* and *scutella* yellow; *wing-joins* black with small yellow spots. *Legs* black, underside of profemora yellowish-grey, coxæ yellow. Abdomen: 1-2 swollen, 3 to middle of 7 very slender, rest of 7-10 somewhat clubbed. Colour black; 1-2 with a clear yellow dorsal mark in the form of a cross; auricles and most of sides yellow; genital appendages of 2 bordered with black; 3, a fine yellow dorsal line, reaching to about 1 mm. from end of segment, a pair of basal yellow spots almost touching above; 4, a transverse yellow basal band and a fine dorsal line about 3 mm. long; 5-6, a transverse yellow basal band; 7, basal half yellow, crossed on each side by a fine black line, rest black; 8, black, a rather large yellow mark low down on each side; 9, black with a basal yellow spot on each side; 10, black. Appendages: *superior* 14 mm., slightly separated at bases, divergent, cornute, slightly hairy, rather slender, very sharply pointed, yellow with black tips; each carries underneath, near its base, a hooked tubercle of fair size, colour yellow tipped with dark brown. *Inferior* bifurcated, the two branches wide apart, short, black, thin, somewhat hooked or turned upward (see Plate xxiii., figs.5 and 6).

Hab.—Kuranda, N.Q. Very rare; November, 1906. A single male taken by Mr. F. P. Dodd.

It is allied to *A. arbustorum* Tillyard, from which, however, it is easily distinguished by the larger and sharper appendages; the bicolorous pterostigma is a feature which I have not noted before in tropical species, though it occurs more or less in all the southern species. Of these latter, *A. ochraceus* Selys, *A. collaris* Selys, and *A. australis* Selys, are all closely allied to the above. All these species have the "seven-mark" not formed, so that in this respect *A. Doddi* is just on the border line between those which possess it and those which do not. The formation of the "seven-mark" is usually complete in the larger species, and incomplete in the smaller.

6. Austrogomphus Risi Martin.

♂. Total length 47 mm., abdomen 36 mm.; forewing 28·5 mm., hindwing 27 mm.

Wings: *neuration* blackish. *Pterostigma* thick, black, 3·2 mm. *Membranule* very minute; slight saffroning on all wings from base to nodus. *Nodal Indicator* 13-14 | 9-10 / 9-11 | 8-10

Head: *eyes* brown; *occipital ridge* 1 mm., black, hairy, with a large yellow plate; *vertex* black, a yellow spot near occiput, the black colour extending to base of front; rest of *front* yellow; *postclypeus* black with a large yellow spot on each side touching the *anteclypeus* which is also yellow; the black on the postclypeus forms an irregular band across the face, narrow at both ends and in middle, swollen in two places; *labrum* yellow with a fine border of black *carrying a row of small yellow hairs*, and crossed in the middle by a black mark; *labium* and *genæ* yellow; *mouth* thickly edged with black. Thorax: *prothorax* black, a triangular yellow mark on collar in front and another behind, with a small yellow double spot just in front of it. *Meso-* and *metathorax* jet black above; the mesepisternum marked with bright orange-yellow as follows: a border-mark; interalar ridge;

a fine mid-dorsal line, 1 mm. long; half-collar marks and dorsal stripes combined together on each side to form an excellent "seven-mark," of which the head is rather short, thick, and blunt; antehumeral stripe narrow, ending in a subtriangular spot near wing-joins. The sides are nearly all bright yellow, there being a touch of black on *E*, a thin irregular black mark along the first lateral suture, and a black spot over the spiracle (see Plate xxii., fig.6); *wing-joins* black, spotted with yellow; *scuta* and *scutella* broadly yellow. *Legs* black, underside of profemora yellow, coxæ pale brownish. Abdomen: 1-2 swollen, 3-6 slender, 7-10 swollen. Colour black, marked with yellow as follows: 1-2, a large dorsal mark, sides and auricles yellow; 3-6, a conspicuous dorsal line reaching along nearly whole of 3-4 shorter in 5, very faint in 6; also on each side a fairly large basal spot joining the dorsal line above; 7, basal half yellow above and also partly on sides, the yellow crossed on each side by a fine black line, rest black; 8, a spot low down on each side; 9, a smaller basal spot, low down on each side; 10, black. Appendages: *superior* 1·4 mm., separate at bases, fairly straight, slightly enlarged inwards near tips, and ending in a short point outwards; slightly hairy, pale yellow. Close up to the base is a curved black tubercle projecting downwards underneath, and not easily distinguished as part of the appendage. *Inferior* very short, thin, black, upcurved (see Plate xxiii., figs.3-4).

♀. Very similar to male, but differing from it as follows. Wings slightly larger; *occiput* with a tiny yellow central tubercle (see Plate xxii., fig 8). antehumeral band of *thorax* broader and more conspicuous. Abdomen broader and more cylindrical; markings of 1-2 very large and conspicuous, leaving only a small portion black on each side; basal spots of 3-4 very large, of 5-6 smaller; 7, basal half light yellow, lower part of sides and underside shaded with olive nearly throughout the segment; 8, a large spot on each side low down; 9, a pair of small basal lateral spots; 10, black. Appendages wide apart at bases, 1 mm., straight, tapering slightly, not very pointed, subcylindrical, hairy, bright yellow, tips shaded with brown.

Hab.—Atherton, N.Q. Rare; April, 1907. A single male, and several females, taken by Mr. E. Allen.

Martin described this species from a unique female (*loc.* Queensland) in the de Selys Collection. I was at first inclined to consider my specimens as a distinct species, partly because of their greater size and some small differences in details of colouration, but more especially because I sent a pair to M. Martin and he did not, apparently, connect them with his type. However, the two agree in all essential points, and in particular, I do not know of any other species in which the *labrum has a black border carrying a row of small yellow hairs*—a most distinctive character for this species.

The specimen in the de Selys Collection must have come from a different locality (possibly Gayndah), and this may account for minor differences.

Mr. Allen notes that the specimens he took were apparently not long emerged, and were flying in the long grass between the creek and railway station; they could have been caught easily by the hand. This is probably, therefore, a winter insect in North Queensland.

7. Austrogomphus arbustorum Tillyard.

At Cooktown, in January, 1908, this insect was only just emerging, and the few specimens I took were considerably smaller than those found at Kuranda.

8. Austrogomphus prasinus Tillyard.

Common at Cooktown, along the Endeavour River, where I found it freshly emerged in January, 1908. The colours are then bright orange-yellow and black, as in *A. Risi* Martin, to which this insect is closely allied. The rich green colour, which suggested the name to me, is clearly only found in the maturer insect.

9. Austrogomphus arenarius Tillyard.

Occurs sparingly in the grass along the banks of the Endeavour River, but is by no means common. There is also in the Macleay Museum, Sydney, a specimen from Derby, N.W. Australia, in which *the last three segments are yellowish.* This condition is associated with the newly emerged insect and probably lasts for some time.

10. Austrogomphus Turneri Martin.

A single female, taken by Mr. H. Hacker, at Rocky, Cape York Peninsula, was given to me in bad preservation. I forwarded it to Mr. Martin for inspection. On its return from Europe it was almost destroyed by *Anthrenus.* This would have been the type-female of this species, only known from a single male in Dr. Ris' collection; but it was too far gone to be of any use. Now that the locality is known, fresh specimens should soon be procurable.

11. Austrogomphus australis Selys.

The only specimen of this, apparently rare, species known to me is a male in the Macleay Museum, Sydney. *Loc.* South Australia.

12. Austrogomphus Gouldi Selys.

Three males, in good condition, are in the National Museum Collection, Melbourne.

{ 13. Austrogomphus lateralis Selys.
{ 14. A. occidentalis Tillyard.

The description of a portion of a specimen from N. Australia, named *A. lateralis* by de Selys, apparently bears some points of resemblance to my *A. occidentalis.* The de Selys specimen is a female, with the abdomen entirely lacking! It is in the British Museum. It is quite possible the two species are very closely allied; the difference of locality is so great that they can scarcely be the same species.

EXPLANATION OF PLATES XXII.-XXIII.

Plate xxii.

Fig. 1.—	*Austrogomphus*	*melaleucæ*, n.sp.	Thoracic	colour-scheme.
Fig. 2.—	,,	*bifurcatus*, n.sp.	,,	,,
Fig. 3.—	,,	*comitatus*, n.sp.	,,	,,
Fig. 4.—	,,	*manifestus*, n.sp.	,,	,,
Fig. 5.—	,,	*Doddi*, n.sp.	,,	,,
Fig. 6.—	,,	*Risi* Martin	,,	,,

Fig. 7.—*Austrogomphus manifestus*, n.sp. Vulvar scale of ♀.
Fig. 8.— ,, *Risi* Martin. Back of occiput of ♀.
Fig. 9.— ,, *melaleucæ*, n.sp. ,, ,,
Fig. 10.— ,, *comitatus*, n.sp. ,, ,,
Fig. 11.—Reference figure for thoracic colour-schemes.

[*A*, mesepisternum; *B*, mesepimeron; *C*, metepisternum; *D*, metepimeron; *E*, mesinfraepisternum; *a*, border-mark; *b*, half-collar mark; *c*, dorsal stripe; *d*, antehumeral stripe; *e*, interalar ridge; *f*, mid-dorsal line; *g*, mesothoracic half-collar; *h*, mid-dorsal suture; *i*, humeral suture; *j*, first or upper lateral suture; *k*, second or lower lateral suture.]

N.B.—The figures are diagrammatic and not drawn to scale.

Plate xxiii.

Fig. 1.—*Austrogomphus comitatus*, n.sp. Appendages of ♂, seen from above.
Fig. 2.— ,, ,, ,, ,, ,, seen sideways.
Fig. 3.— ,, *Risi* Martin ,, ,, seen from above.
Fig. 4.— ,, ,, ,, ,, seen sideways.
Fig. 5.— ,, *Doddi*, n.sp. ,, ,, seen from above.
Fig. 6.— ,, ,, ,, seen sideways.
Fig. 7.— ,, *bifurcatus*, n.sp. ,, ,, seen from above.
Fig. 8.— ,, ,, ,, ,, seen sideways.
Fig. 9.— ,, *melaleucæ*, n.sp. ,, ,, seen from above.
Fig. 10.— ,, ,, ,, ,, seen sideways.

All figures much enlarged and drawn to scale.

STUDIES IN THE LIFE-HISTORIES OF AUSTRALIAN ODONATA.

i. The Life-History of *Petalura gigantea* Leach.

By R. J. Tillyard, M.A., F.E.S.

(Plate xxiv.)

The student of Nature who lives in a country like Australia, where new forms are still to be found everywhere, will, it is to be hoped, refuse to be carried away by the mere desire of describing and naming them, and treating them as mere specimens to be put away labelled in a cabinet. A chapter in the book to which he aspires to contribute should not be all, as it were, index. The most important part of the work to be done is not the mere "manufacturing" of new species, nor the "proposing" of new genera. Important as these may be for the furtherance of the systematic study of groups, yet of far greater value, both to the systematist and the nature-lover, is the study of the individual life of new forms. The era of mere species-making is passing away, and the demand is more and more for light to be thrown on the strange habits of unknown Nature.

I feel that I owe an apology to many who passed over my first attempt at a "life-history" without comment, for that somewhat crude, and, in one respect at least, inaccurate account of the life-history of *Lestes leda* Selys, contributed by me to these Proceedings in 1906. Before entering on further work of the same sort, I am bound to correct the error, first pointed out to me by Mr. W. Gurney, which I made concerning the oviposition of that species. Mr. Gurney has seen the male and female descend into the water and place their ova in the tissues of water-weeds; and I have, since that time, repeatedly seen the oviposition carried on in a similar manner, but with only the tip of the female abdomen submerged. One can often gather a stem or leaf of water-weed punctured all over by this common insect, and a little careful observation will show the colourless transparent eggs in the tissue.

Since I wrote the paper referred to, I have been able to obtain many useful works of reference on Odonata which I lacked before, and from which it is clear that the general habits of the genus *Lestes*, with one or two exceptions, are the same the world over. With the detailed knowledge contained in the works of de Selys and others, it would have been impossible to have committed the error I did. I have therefore studied carefully all the information I have been able to obtain concerning the known life-histories of species from other countries, before venturing to publish any more of my own observations on Australian species.

Many species are exceedingly difficult to keep and breed out in aquaria. They apparently do not take kindly to artificial conditions. One has to be always on guard against their cannibalistic propensities, and only a few nymphs of any of the larger kinds can be kept with safety even in a large aquarium. Worst of all is the apparent inability of the full-fed nymph,—in the case of the *Libellulidæ* and *Gomphinæ*—to climb out of the water and undergo transformation. Only with the greatest difficulty can they get up slanting twigs; and it is necessary, for success, to give them a shelving bottom up which they can crawl to dry land. Once out of the water, they seem able to negotiate vertica stems of grass or twigs with fair success, although they generally prefer a clump of several stems together, or, in many cases, remain on the ground to undergo the change.

Breeding the nymph is after all only a small part of the study of life-histories. More can be done by spending long days in the spring and summer, watching the insects in their natural haunts. Besides the method of oviposition, there is need to observe carefully the methods adopted by the males to capture the females and hold them securely during the process of copulation. In this act the accessory appendages of the male, and the head and thorax of the female play a prominent part, and the exceeding difficulty of capture and copulation on the part of some dragonflies is evidence of special precautions developed by Nature to prevent hybridisation. In those families where one form and one colour-pattern predominate, many species can scarcely be distinguished except by means of the parts used in coition, and these may be so diverse in closely allied species as to prevent the accidental copulation of the male of one species with the female of another, captured by mistake. I have myself seen a male of *Austrogomphus collaris* Selys, seize a female and vainly attempt copulation. After a considerable time the attempt was abandoned, whereupon a second male seized the same female and effected connection almost immediately. Here there was probably some local deformity in the first male, which prevented him either from holding the female securely or from completing the act of coition.

The method of oviposition apparently determines the shape of the egg, and often the habits of the larva. In all species where the egg is deposited in tissue by means of the sharp ovipositor of the female, it is of an elongated oval shape, evidently a suitable form for inserting into the narrow opening prepared for it. Where the egg is dropped into the water straightway, it is usually broadly elliptical or almost round, and the vulva of the female possesses no true boring apparatus. Again, the larvæ of nearly all the former species—those having elongated ova—are clean-living insects, inhabiting floating masses of waterweed; while those of the latter crawl on the trashy bottoms or burrow in the sand or mud, and are often very hairy and covered with mud.

The life-histories of all those species peculiar to Australia—with the exception of *Lestes leda*—are quite unknown. Included amongst these are many ancient and isolated forms, true collective types, with no very near allies in other parts of the world; such for example as *Cordulephya*, *Synthemis*, *Petalura*, *Diphlebia*. The larvæ of these four are amongst the greatest desiderata of present-day systematists in Odonatology, and much light may be expected to be thrown on the present methods of classification by their discovery. Fortunately, species of all four genera occur, though not commonly, within 100 miles of Sydney. I have, therefore, while not neglecting less interesting forms, paid as much attention as possible to these, and have achieved a fair measure of success with them. In the first part of this paper, then, I offer the results of my observations upon that remarkable denizen of the Blue Mountain region, *Petalura gigantea.*

The apparent rarity of this huge dragonfly made me almost despair of ever discovering anything about it. During my first four years in Sydney I never saw a single specimen on the wing, though I received on an average about one a year from friends who visited different localities in the Blue Mountains. Mr T. Steel, who has been kind enough to send me from time to time dragonflies from various localities, assured me that he had seen this insect fairly commonly one year in an open space near the Katoomba railway station. This remark put me on the right track. I determined to spend much of my spare time last season in the vicinity of Katoomba For this purpose I selected the small creek running over the Leura Falls, and nearly every Saturday during November and early December, 1908, I made the journey up to Leura and spent all day on the creek. Careful dredging of the weeds and sandy bottom of the clear running stream yielded few larvæ of any kind, the creek being little more than a rocky cataract in most places. Working up, however, away from the Falls, the source of the stream is reached in little over a mile, and consists of a large teatree swamp, at the head of which there is nothing but vile mud and decaying vegetable matter, of an average depth of one foot or more. On November 21st, 1908, just as I had decided to give up for the day, I found my first pair of *Petalura* exuviæ clinging to grass stems above a small mud hole of filthy mud and water that had clearly been made by a post, since removed. During the weeks that followed, I found many exuviæ, several just transforming, in the teatree stems and clumps of sedge in this muddy swamp. The matted stems of decayed vegetation made it quite impossible to use the net here to find living larvæ; nor was it possible to turn over large quantities of the evil-smelling mass with the hands, so that I had to be content with the exuviæ, some specimens of which are quite perfect and quite as satisfactory as the living larva itself would have been.

Later on, in December, I took upwards of two dozen of the perfect insect in and about this swamp; in fact, they might be described as being fairly common in a restricted area of only a few acres. Outside of that, only a stray male was occasionally to be seen. I was able to determine many interesting points in their habits, though there are still one or two points requiring further elucidation. The following are the results of my study of this species in its native haunts :—

Method of Pairing.—Bearing in mind the unique form of the male appendages, I was most anxious to secure a pair in cop., to see how the male managed to hold the female firmly. During two visits I failed even to observe a pair together. On the next occasion I flushed a pair that had settled on a low bush. They dashed off at a terrific speed, crossed the creek, and settled on a branch of a large Eucalyptus. After approaching carefully, I was able to get underneath them and watch them, but they were too far above me for me to be certain of anything. A week later I came again to the same spot expressly to look out for pairs. Once a pair passed me flying swiftly, with the male apparently holding the female *by the underside of the head*; but this pair separated after executing several gyrations in the air, so that I could not be certain that the male had got a proper hold. Later on I captured another pair settled in some teatree, but unfortunately they separated immediately in the net. Finally, good fortune came my way, in the shape of a pair flying rapidly with the wind straight towards me. I held up my net and they flew straight in, and remained clinging to it. Not until I actually took hold of him did the male release his hold, so that I saw clearly the position he was in. The wide inferior appendage, pointed on each side, was pressed down tightly on the occiput of the female, on which a *very slight* eminence appeared to give a remarkable good hold. By this means the head of the female was pressed well back. The two large leaf-like appendages enclosed the shoulders of the female, over which they fitted exactly. When the male exerted his full strength, these were pressed so far down as to bring the back of segment 10 of his abdomen into contact with the thorax of the female, and, at the same time, the head of the latter came back so far that the superior appendage became firmly wedged between the shoulder and the back of the eye. This pair was killed and set in position, but, during the process of drying, the original rigid position could not be retained. The sketch in Plate xxiv. (fig.1) shews them as they are at present in my collection, and may be taken to represent exactly the position of the appendages of the male *on first seizing the female.* It can be easily seen how further downward pressure would bring the dorsum of segment 10 of the male on to the thorax of the female, and the back of the eye of the female on to the superior appendage of the male. The whole position gives a strong grip, and justifies the existence of the petaloid appendage as a useful organ.

The most remarkable feature of it is, I think, the position of the inferior appendage. The occiput of the female has no large prominences or depressions, but its slightly raised surface seems to fit exactly the broad appendage of the male; while the curvature of the latter is such that the application of downward pressure from the abdomen forces the head of the female back, and, at the same time, keeps the appendage firmly in position where a slightly straighter appendage would most certainly slip.

When firmly held together, the pair rises into the air, and after a few preliminary evolutions makes straight for some high tree, on the branches of which they settle during the act of copulation. I have sometimes seen a second male, or even two, attack them when paired, but they did not succeed in effecting a separation. The seminal vesicle appears to be charged by the male *after pairing* and during the gyratory flight. He doubles himself completely up, and evidently only effects the operation with some difficulty, as he has to keep a firm hold of the female and also raise her with the end of his abdomen.

Oviposition.—After copulation, the pair separate, and the female hides herself in the teatree scrub at the head of the marsh.

I tried several times to watch the process of oviposition, but the females were so wary that they flew off rapidly as soon as I got close to them. All I can be certain of is that they are *not* accompanied by the male, and that they do not fly hither and thither over the marsh dropping their eggs into it. Every female I flushed appeared to be settled on or near the ground at the edge of a mass of decaying vegetable mud. The probability is that the eggs are actually inserted in decaying tissues. The female possesses a peculiar curved ovipositor, apparently quite suited to this purpose, and the shape of the egg also suggests it.

Ovum (Plate xxiv., fig.2), 1·7 mm. long, elongate-oval, semi-transparent, yellowish; pointed at one end, rounded at the other.

Larva-Nymph.—The larva lives in the foul muddy ooze of the teatree swamps, where there is no real standing water. It may in truth be said to be only semi-aquatic. During the summer these swamps become quite dry. Hence we must conclude either that the larva is perfectly able to exist on dry land, or buried in the dried mud; or that the egg does not hatch until the autumn. In either case, I think there is very little likelihood of its development extending over more than one season. An examination of the ooze will show that it contains hundreds of insect larvæ suitable as food for the voracious *Petalura*, and its growth is probably exceedingly rapid in so favourable a position.

The exuviæ are found clinging to the tufts of sedge or on to trunks of teatree, often being 2 or 3 feet above ground. They are very difficult to dislodge, the strong curved tarsal claws giving such a firm hold that usually the whole leg will come out of its socket before the tarsus can be freed. The only way to get perfect specimens is to take them as soon after emergence as possible, choosing those that have climbed into clumps of sedge. Cut the sedge with the scissors above and below the larva; it will then be found that each stem will slide out of its own accord. Some of these larvæ crawl three or four yards out of the mud before climbing a suitable twig. They are all caked with mud. In one part of the swamp they were all orange-yellow, in another grey, and in the peaty portion dull black.

The exuviæ, on being cleaned, show practically no pattern, The following is the description (Plate xxiv., fig.3):—

♂. Total length 49-50 mm. Head rather flat above, 10 mm. wide; *eyes* fairly large, not prominent; *back of head* well rounded, a small tuft of hairs just behind each eye; *ocelli* small, in a triangle, reniform; *antennæ* 5 mm. long, seven-jointed, curved (Plate xxiv., fig.5), the joints shaped as follows: 1, enlarged, hemispherical; 2, narrower, oval; 3, very narrow, cylindrical, longer than 2; 4, short, oval; 5, nearly twice as long as 4, oval, wider; 6, longer than 5, oval; 7, narrow, cylindrical, not so long as 5; *frontal ridge* small and narrow; *labrum* broad. Labium (Plate xxiv., fig.4) when folded naturally, 9 mm. long, greatest breadth 6·5 mm., joint of mask reaching to just behind procoxæ; *mentum* strong and thick, rectangular, rather flat, concave in middle as seen from below; a tuft of hairs on each side just below joint of lateral lobe; front edge of mentum projecting in a triangle in the middle, a small set of hairs on each side; *lateral lobes* 3 mm. long, 1·7 mm. wide in middle, outer border very slightly curved, rather square at top, inner border more curved, no angle or indentations at apex; *movable hook* 1·4 mm., very strong and thick, pointed, basal joint placed about three-fourths of the way along outer edge of lobe; edges of lobes well ridged, neither mental nor lateral setæ present. Thorax: *prothorax* well formed, nearly as wide as head, not ridged. *Meso-* and *metathorax* rather short, 10 mm. wide, fairly well rounded on each side. *Wing-cases* 13 mm., lying parallel along back of abdomen (in some exuviæ they are turned in all directions), hindwing projecting about 2 mm. beyond forewing and reaching to end of segment 4; width of forewing case 2·5 mm., of hindwing case 3 mm. *Legs* very stout and strong; *coxæ* rather large, 2 mm.; trochanters narrow, 1·5 mm.; measurements of femur, tibia and tarsus respectively as follows: foreleg, 8-9-3 mm.; middle leg, 9-9-3·5 mm.; hind leg, 13-11-5 mm. A tuft of hairs in front of profemora near bases, also a few hairs on protibiæ. *Tarsi* (Plate xxiv., figs. 8-9, protarsus) ending in two strongly pointed spines or hooks, much curved, above which are two smaller spines, also curved;

each tarsus is apparently 3-segmented; the divisions not clearly shown, but apparently slanting forward, and the two basal segments short and carrying a set of longish hairs on the inner side; end of tibia also with spines on each side, especially on the forelegs. Abdomen: length 32-33 mm., greatest breadth 10 mm. at segment 6; subcylindrical, widest at 6, then tapering to 10, which is only 4 mm. wide; dorsal surface well rounded, ventral surface rather flat, segments 1-8 carrying below two deep parallel indentations, separating each segment into a large and somewhat convex central area and a pair of narrower side-portions; *genitalia* showing plainly beneath 2 and basal half of 3. Segments 5-9 with soft hairs along apical sutures. Appendages (Plate xxiv., fig.6; *s*, superior; *i*, inferior appendage) of remarkable form; the superior appendages appearing as small rounded projections on each side, and the wide inferior appendage lying between and *above* them; anus lying between and somewhat below superior appendages, distinctly ridged underneath. The two small tubercles just visible on each side of the inferior appendage represent the two sharp points in the imago.

♀. Measurements usually the same as in the male (I have one dwarf female only 45 mm. long). *Abdomen* slightly wider and more cylindrical from 1-8. Segment 9 with ovipositor showing beneath as a broad and rather blunt curved projection reaching just on to 10. Segment 11 (= appendages in imago) somewhat tetrahedral in shape, with anus rather high up (Plate xxiv., fig.7, *a*, anus; *b*, ovipositor).

In a newly emerged male taken by me, the superior appendages were soft and damp, hanging straight downwards; the inferior was of a pale yellow colour and rather harder, and still having its side points above the superior. Evidently the insect places the latter in position by a muscular effort as soon as they are strong enough. I have also noticed that an immature male captured and placed in a paper triangle, will often force its inferior appendage up into position above the superior ones, which he depresses. Even in their natural position the points of the inferior appendage practically rest against the superiors.

Seasonal Range of Imago.—My first two exuviæ were found on November 21st, 1908; and new ones continued to be found up to December 12th. On December 5th, two males were found just emerging. On December 17th, no new exuviæ were obtained, and many of the imagines were considerably torn and aged. I have never seen this species during visits to Katoomba in early February. Hence its seasonal range is certainly a very short one, extending from the third week in November to about the end of January at the very latest. It is doubtful if many imagines would be found even in January.

Hab.—Blue Mountains and their southern and coastal spurs, N.S.W.

The *Petalurinæ* are, at the present time, only a remnant of a race long past its prime. Included in the subfamily are four genera: *Petalura* (Australia), *Uropetala* (New Zealand), *Phenes* (Chili), and *Tachopteryx* (N. America). A single female exuviæ of the latter has been described by Williamson (Entomological News, 1901, 12, 1-3, Pl. i.). A diagram of the labium and an antenna is inserted here for purposes of comparison. It will be seen that, broadly speaking, the labia of *Tachopteryx* and *Petalura* are very similar. The chief differences are as follow. In *Petalura* the mentum is not so wide as long; in *Tachopteryx* it is wider than long. The middle of the front edge of the mentum in *Petalura* projects forward in a triangle; in *Tachopteryx* it is slightly indented medially. The lateral lobes and movable hooks are very similar in both, though in *Tachopteryx* the former are apparently somewhat longer and narrower, and with the apices more suggestive of the *Æschnid* type than in *Petalura*.

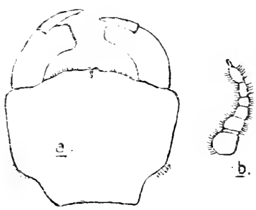

Fig. 1.—*Tachopteryx thoreyi* Selys (after Williamson). *a* labium, *b* antenna.

The antennæ agree in being seven-jointed. In the *Gomphinæ* they are usually four-jointed; in the *Æschninæ* a short, thick, basal joint is surmounted by five or six slender joints forming a slender filament. The antennæ of *Tachopteryx* are hairy, those of *Petalura* smooth; while the joints of the latter are considerably longer and narrower than those of the former. It should be noticed that, in each, the fourth or middle joint is the shortest.

Like *Petalura, Tachopteryx* deposits its eggs in wet boggy places where there is scarcely any water. The habits of the two nymphs are probably exceedingly similar.

The only other *Petalurine* nymph known is that of *Uropetala carovei* White, discovered in New Zealand, and figured by Hudson ("Neuroptera of New Zealand"). The figure is a "popular" one, badly drawn, and nothing can be gathered either from it or the description.

If any lesson is to be drawn from the study of the early stages of *Petalura*, it seems to me to be that it is in reality a nearer approach to the *Æschnine* type than the *Gomphine*. If we could go back far enough to find the common ancestor of the two, would not its nymph show considerable similarity to that of *Petalura?* We might even trace the divergence of the two groups from one simple circumstance, viz., the natural selection of running water or stagnant marsh for the passing of the early stages. Given the former, it is clear that the ovipositor of the female would be brought more and more into use as a true "borer" by means of which the eggs might be safely lodged in stems in the quiet corners of a rushing stream; the body would become more slender, the antennæ more filiform; and the whole insect more active, thus producing the clean-living *Æschnid* type. On the other hand, if the female continued to deposit her eggs in the mud, what more natural than that she should gradually relinquish the use of the "borer" and just drop them into the mud, like the *Gomphinæ!* And the egg itself, being no longer inserted into a narrow cleft, but merely dropped, would tend to assume the more spherical form now found in all those families where the boring apparatus of the female has gone out of use. Later on, at a time perhaps when the huge swamps of the Mesozoic age were drying up and giving place to definite stream-beds, these early ancestors of the *Gomphinæ* would again be compelled to take to the rivers, where they would naturally seek the protection of the river-bottoms by burrowing or burying themselves under trash and rubbish. Hence might arise a gradual reduction of the joints of the antennæ, the slender seventh joint first becoming obsolete, then the sixth and fifth, and finally the already small and weak fourth joint, which we now find in a rudimentary state in the present *Gomphinæ*. Or the continual burrowing might have so weakened these organs as to cause the total disappearance, at the same time, of the three top-joints together; the antenna naturally giving way at the weak small joint, and conserving its remainder by the strengthening and broadening of the large third joint which we find in so many *Gomphinæ*. Looked at from this point of view, the *Petalurine* nymphs are objects of great interest and of much speculation about the past. While we can never be certain, yet these ancient types point out the way by which natural selection has worked its changes in past ages, and lend support to theories which must command our attention and interest.

In conclusion, *Petalura* is probably the oldest type of nymph yet discovered. *Tachopteryx* apparently represents a very slight departure from the older form, the change being best seen in the shortening and thickening of the antennæ, which represents a tendency towards the *Gomphinæ*; and a slightly more developed labium, which might also be regarded in that light, or possibly as a tendency towards the *Æschninæ*.

EXPLANATION OF PLATE XXIV.

Petalura gigantea.

Fig. 1.—Sketch showing method of attachment between male and female preparatory to coition.

Fig. 2.—Ova (enlarged).

Fig. 3.—Exuviæ of male nymph (enlarged).

Fig. 4.—Labium of ,, ,,

Fig. 5.—Antenna of ,, ,,

Fig. 6.—End of abdomen of male nymph; *s*, superior appendage; *i*, inferior: (enlarged).

Fig. 7.—End of abdomen of female nymph; *a*, anus; *b*, ovipositor: (enlarged; seen sideways).

Figs. 8-9.—Protarsus of female nymph (enlarged).

DIURNAL VARIATIONS IN THE TEMPERATURES OF CAMELS.

By J. Burton Cleland, M.D., Ch.M.(Syd.).

In October, 1907, I had the opportunity of taking the temperatures, on various occasions, of a certain number of 500 camels recently imported from India, and quarantined in the north-west of Western Australia, on an open spinifex (*Triodia*) plain. The days were usually hot (often over 100°F. in the shade), and the nights decidedly cool. The results, though comparatively few, seem to indicate that the camel resembles, to some extent, cold-blooded animals such as reptiles, inasmuch as there is a wide range of temperature, varying with external conditions, the oscillations sometimes being as much as nearly 8°F.

The low temperatures, it will be noted, occurred, as was to be expected, in the morning, and they only gradually rose as the day became warmer. Further, the animals, before these temperatures (always rectal) were taken, were often restless and eager to be off in search of food, and had not necessarily just awakened from sleep. The subnormal temperature would appear to be due to the coolness of the morning, the lack of active exercise with its metabolism, and perhaps also to the completion of rumination some time previously.

The higher temperatures found in the evening, after hot days, are perhaps to be attributed, in great measure, to the fact that camels visibly "perspire" only over a small area on the back of the neck. This area would seem to be far too small, considering the bulk of the animal, to assist materially in coordinating the body-heat to a constant mean temperature in the presence of great solar heat and muscular exercise; and hence the keeping down of the temperature, under these conditions, must depend chiefly on invisible perspiration and vaso-motor processes. This small amount of visible perspiration, by conserving the animal's water-supply, is doubtless of great advantage to a creature inhabiting arid regions.

It may be of interest also to bear in mind, in connection with this reptilian temperature-trait, the fact of the oval shape of the red corpuscles of camels, which, though not nuleated, thus far also resemble those of reptiles and birds. One cannot see any actual relation between these two reptilian traits in camels. The camel, being a ruminant, has presumably evolved along with other ruminants, and, in consequence, its ancestry must be supposed at one time to have possessed round corpuscles like other ruminants, and so on, dating back to marsupial or premarsupial times. The appearance, then, of an oval corpuscle would seem to indicate either an atavistic (or rather reversionary) phenomenon, or a new evolutionary departure suiting the structures of the animal. Recently the view has been propounded that the appearance of one reversionary character, or of some new departure, may be associated with others not apparently related to it; and that, by artificial selection, an attempt to breed a stock containing the one will lead to the production of a race in which both are stable. Can the appearance of the one trait, being of use to the animal in some way, by natural selection have rendered the other permanent also? On the other hand, what conceivable advantages can there be to camels to possess either oval red cells, or a temperature varying considerably with their external surroundings? Perhaps the soundest view to take will be to consider the oval red corpuscles as having arisen by a pure mutation, of no particular economic value even physically, and the oscillations of temperature as the result of a successful attempt to conserve water.

The following are some of the results found :—

Table i.

Camel		
88.	About 6 p.m. Oct. 10th, 100°F.	About 7 a.m. Oct. 11th, 94·4°F.
91.	" " 99·4°F.	" " 96·1°F.
93.	" " 101·4°F.	" " 94·2°F.
96.	" " 99·7°F.	" " 95·7°F.
100.	" " 100·2°F.	" " 94·2°F.

Table ii.

To show the gradual rise in temperature amongst 36 camels tested consecutively as the day rapidly increased in warmth, from 8 to 10 a.m. on October 12th.

Camel.	T.°F.	Camel.	T.°F.
75.	95·5	80.	97·1
69.	95·4	74.	96·2
9.	96·7	38.	97·2
13.	95·5	28.	97
3.	96·2	40.	95·1
59.	96·4	8.	96·1
Average of 6=95·95°F.		Average of 6=96·58°F.	

Camel.	T.°F.	Camel.	T.°F.
27.	96·5	25.	96·4
66.	96·6	4.	95·2
56.	96	29.	96·4
1.	95·6	55.	98·4
24.	94·8	44.	96·5
12.	97·4	33.	25·8
Average of 6=96·15°F.		Average of 6=96·62°F.	

Camel.	T.°F.	Camel.	T.°F.
18.	96·7	41.	96·1
32.	95·5	37.	97
71.	96·2	43.	98
43.	96·3	41.	97·2
65.	96·5	43.	98
52.	97	36.	98·8
Average of 6=96·38°F.		Average of 6=97·64°F.	

(Note.—The intervals between the taking of the temperatures in the last batch of six camels were much greater than in the previous batches on account of these animals having to be searched for in a mob of 87.)

Table iii.

To show the effect of fever (Trypanosomiasis, Surra) in a camel, modified by the diurnal variation.

Evening of Oct. 10th—Average T. of 13 healthy camels, 100·07°F. T. of surra camel, 102°F.

Morning of Oct. 11th—Average T. of 5 healthy camels, 94·9°F. T. of surra camel, 99·4°F.

Evening of Oct. 11th Control camel, 101·8°F. T. of surra camel, 104°F.

WEDNESDAY, JUNE 30TH, 1909.

A Special General Meeting, together with the Ordinary Monthly Meeting of the Society, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, June 30th, 1909.

Mr. C. Hedley, F.L.S., President, in the Chair.

SPECIAL GENERAL MEETING.

Business: The amendment of Rules ii., iii., iv., vi., viii., and xlvii., with a view to the admission of Women to full Membership.

On the motion of Professor Wilson, seconded by Mr. J. E. Carne, it was resolved :

That Rule ii. be amended

(a) By the omission of the word "Associates" (line 1).

(b) By the substitution of the words—Eligibility to all forms of Membership shall be without distinction of sex—for sentence 3 ["Associate Members shall consist of Ladies only, and shall be entitled to all the privileges of Ordinary Members, except the right of attending Meetings of the Society, and of having a voice in its conduct or management."]

(c) By the substitution of the word—Persons—for the word—"Gentlemen" (line 7).

In moving the Resolution, Professor Wilson quoted the following extract from the Presidential Address delivered by the late Professor W. J. Stephens, M.A., on January 27th, 1886, the occasion being the anniversary of the Meeting at which it was arranged to admit women as Associate Members—"This enlargement of the Society's sphere is admittedly only tentative, and may probably be increased hereafter by the admission of all members to full rights without distinction of sex, following the improved practice of the Sydney University in this respect."

On the motion of Mr. H. J. Carter, seconded by Mr. Henry G. Smith, it was resolved:

That Rules iii., iv., vi., viii., and xlvii., be amended as indicated hereunder (consequential alterations):—

(a) Rule iii., by the omission of the words—"or Associate" (lines 1-2).

(b) Rule iv., by the omission of the words—"or as an Associate" (lines 1-2).

(c) Rule vi., by the omission of the words—"and for Associate Members the Annual Subscription shall be one guinea, without Entrance Fee" (lines 3-4).

(d) Rule viii., by the omission of the words—"or Associate" (line 1).

(e) Rule xlvii., by the omission of the words—"subject to Rule ii." (line 1).

The President announced that a Special General Meeting would be held on Wednesday, 28th July, 1909, before the Monthly Meeting to be held on the same date. *Business*: to confirm the amendment of Rules ii., iii., iv., vi., viii., and xlvii.

Professor Wilson gave notice of motion—That, on the confirmation of the amended Rules, the existing Associate Members shall be recognised forthwith as Members.

ORDINARY MONTHLY MEETING.

Mr. C. Hedley, F.L.S., President, in the Chair.

Messrs. B. B. A. L. Jardine, Somerset, Q.; E. F. Hallman, B.Sc., Forest Lodge; Max Henry, M.R.C.V.S., Carlingford; G. P. Darnell Smith, B.Sc. Bureau of Microbiology, Sydney; and G. H. Tillbrook, Sydney Training College, were elected Members of the Society.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 4 Vols, 55 Parts or Nos., 9 Bulletins, 1 Report and 8 Pamphlets, received from 50 Societies, &c., were laid upon the table.

NOTES AND EXHIBITS.

Mr. Hedley shewed examples of the rare Carrier-Trochus (*Xenophora*) dredged off the coast of New Zealand by Captain Bollons of the Government steamer "Hinemoa."

Mr. David G. Stead exhibited and recorded us an addition to the fish-fauna of New South Wales, a specimen of the remarkable fish known as the "Moorish Idol," *Zanclus cornutus* (Linn.). This fish is looked upon as a tropical species; and its occurrence on this coast so far south as Botany Bay (where the example exhibited was obtained) is, therefore, of some interest.

Mr. Cambage exhibited herbarium specimens, timber, bark, oil and seedling plants in illustration of his paper describing a new species of Eucalyptus (*E. parvifolia*).

Mr. Rainbow sent, for exhibition, a living and also a preserved example (♀) of an aquatic spider, *Dolomedes facetus*, L.K., from Duck Creek, near Clyde. This exceedingly pretty spider is chiefly interesting from the fact that it lives under water. It constructs an irregular web amongst weeds or stones in stagnant or sluggish waters. The body of the animal is densely clothed with "down" which not only enables it to collect sufficient air, so that it may remain submerged for hours, but also keeps the body dry. It cannot dive like the "diving-bell" spider of Europe, but when it descends below the surface-film it has to pull itself under by grasping stems or leaves of plants. When disturbed, it comes to the surface of the water, over which it skates rapidly in quest of a place of safety. The species was described and figured by Koch in "Die Arachniden Australiens" (B. ii., p. 869, T. lxxiv., figs 5-6). The figures are indifferent, the legs being shown far too long and tapering; the head too sharply truncated in front; and the colour-pattern ill defined. The species has a wide range, from Rockhampton to Sydney; it also occurs in New Zealand and upon the island of Upolu. The spirit specimen was an immature female. It fell a victim to the cannibalism of the living example.

Mr. Sloane exhibited a collection of Cicindelids in illustration of his paper; and he gave a summary of the views of Dr. W. Horn on the geographical distribution of the *Cicindelidæ*, as enunciated in his important contribution to Wytsman's "Genera Insectorum" (1908).

Dr. Stokes showed some caddis-worms and their cases; the former are apt to be a nuisance in cement-lined water-channels, because of their propensity for collecting grains of sand, to be utilised in the construction of their cases, should the cement become sufficiently softened.

STUDIES ON TUNICATA.

No. I.

By H. Leighton Kesteven, B.Sc., Junior Demonstrator in Physiology, Sydney University; Lecturer in Physiology, Technical College, Sydney.

(From the Physiological Laboratory of the University of Sydney.)

(Plates xxv.-xxvii.).

Introduction.—In the series of papers hereby commenced, I hope from time to time to contribute to our knowledge of the Australian Tunicate fauna.

Thanks to the excellent work of Professor Herdman, the student of Australian Tunicata is very fortunately situated. In his "Catalogue of the Tunicata in the Australian Museum," Professor Herdman gave a classified list, with bibliographical references, of all the species recorded from the Australian coasts. That list is a guide to past work, and such a guide is invaluable.

Of the one hundred and eighty-three species recorded, the greater number have been well and adequately described; there still remain unattached names, notably those of Quoy and Gaimard, and of Stimpson.

In these papers it is my purpose to record the recognition of these poorly described species as opportunity offers, to note extensions of ranges of those better known, to describe any new forms that may occur to me, and to record any other observations that may be of interest to the general subject.

For the guidance of collectors who may be willing to assist me with material, I may say that I should like the specimens to be placed in 5 % formol (2 % formaldehyde) in sea-water directly collected, and after two or three days to be transferred to 50 %

alcohol. Simple ascidians with tough tests should be carefully slit open distal to the siphonal apertures. Precise information as to habitat and degree of rarity or otherwise should, whenever possible, be made available; it is often by such information, as much as by the characters of the animal, that one is enabled to identify the meagrely described species, *cf.*, *Ciona intestinalis* var. *sydneiensis*, and *C. intestinalis* var. *diaphanea*, below.

Genus Sidneioides, gen.nov.

Colony formed of a number of shortly pedunculated lobes, arising from a flattened base.

Systems irregular, simple, one, two or three to a lobe.

Ascidiozooids elongated and distinctly divided into regions, marked constriction between abdomen and postabdomen, oral apertures six-lobed, atrial simple, not provided with a languet.

Test soft cartilaginous, but tough and membranous.

Branchial sac very well developed, long and narrow.

Alimentary canal long, forming an open loop; stomach thick, smooth.

Postabdomen fairly long, torpedo-shaped.

Reproductive organs : testes in the postabdomen; ovary in the atrial chamber.

Type : *S. tamaramæ* Kesteven (*infra*).

The form for which this genus is proposed, differs from other Ascidians in the situations of the two gonads; since this character is described in detail in the specific description, it need not be further referred to here.

Disregarding, for the present, the character of the genitalia, the following points of similarity and dissimilarity to members of other genera are worthy of notice.

Sidneioides may be said to combine the characters of *Sidnyum* and *Polyclinum*; in general features it closely resembles both, differing from the former and resembling the latter in having the wall of the stomach smooth; and resembling the former and differing from the latter in the absence of an atrial languet.

I propose to regard the novelty as a member of the Polyclinidæ, intermediate between *Polyclinum* and *Sidnyum*.

If, as Herdman* has suggested, *Aurantium* is a group of insufficient importance to warrant its separation from *Polyclinum*, then it is only necessary to modify his dichotomous key (*l.c.*, p.616) to the genera of the POLYCLINIDÆ as indicated below, to make a place for the new genus.

6 { Both gonads in the postabdomen.......... ....*Polyclinum.*
Ovary in the atrial cavity, testes in the postabdomen.........*Sidneioides.*

SIDNEIOIDES TAMARAMÆ, sp.nov.

(Plates xxv., fig.9; xxvi., figs.1-6).

External appearance.—The colony consists of many separate, shortly pedunculated lobes closely packed together to form a bun-shaped, or hemispherical ascidiarium. The peduncles of the individual lobes are all united to a flat basal, stolonial expansion which, in turn, is attached to a substratum of rock and barnacles. This stolonial basis is only about one-half the diameter of the colony, so that the lobes radiate as from a common centre. The colour of the ascidiarium is dull grey, due to the presence of small, densely packed, incrusting sand-grains imbedded on the surface of the test. The distal surface of each lobe is flat, and bears round its edge a slightly prominent ridge, and towards its centre, one, two or three fairly prominent papillæ, the orifices of as many cloacal chambers. The largest colony of normal growth had a maximum length of 40 mm., and diameter of 60 mm.(Plate xxvi., figs.5-6). The ascidiarium above described is such as grows on a flat surface; those growing in confined rock crevices adapt themselves to the irregularities of their situation and assume very various shapes.

The ascidiozooids (Plate xxv., fig.9) are all arranged vertical to the free surface, and, therefore, like the lobes, radiate as from a centre; they present the tripartite division of the body characteristic of the family. The total length varies from 17-23 millimètres. The relative proportions of thorax to abdomen to postabdomen are approximately 13 : 9 : 9. The diameter of the

* Herdman, Journ. Linn. Soc. xxii., 1891, p.618.

thorax is fairly constantly 2·5 mm., that of the abdomen half of this, and of the postabdomen a little more than half this again. The length of the postabdomen is variable. In preserved specimens the six-lobed oral siphon (Pl. xxv., fig.9) is found to be well, though not deeply retracted; the simple atrial aperture, nearly level with the oral, is probably much nearer its normal position. The vascular appendages are simple tubular unbranched structures.

The common cloacal chambers are small and flattened in the plane of the surface of the colony. From each chamber a variable number of tubular diverticula extend between the ascidiozooids to their respective atrial siphons. Those to the nearest individuals take a nearly straight course; to those more distant the tubules radiate out parallel and close to the surface of the test, and then dip directly down to their destination. These tubules, though composed of test, lined by an epithelium, are not merely excavated in the test, but lie more or less free and often come away attached to the siphon (see fig.9).

Systems, though undoubtedly present, are so variable as to be undefinable; there were apparently ten individuals in one system counted.

The test, owing to its strengthening of sand-grains, is firmer on the surface than within; in consistency it is intermediate between cartilaginous and gelatinous; and, owing to the close packing of the ascidiozooids, which reduces the test to a minimum, it may be aptly described as membranous. The cells are very numerous, and of two kinds. The more numerous form (Plate xxvi., fig.3) has an approximately oval shape rendered irregular by the expanded bases of extremely fine dendritic processes of great length, given off from both ends. These processes are very occasionally seen after staining with eosin, but, on using Van Gisson's picro-acid fuchsin, they show up very distinctly, and by a sufficiently high magnification the test is shown to be pervaded with these processes; their tenuity is of about the same order as that of white fibres of mammalian areolar tissue. Cells of the second form are of the usual spindle type; a few of the normal stellate type are also present, but these are rare. Bladder and pigment cells are absent. Vessels also are absent; their function is probably subserved to some extent by the lacunæ in which the spindle cells lie; one quite often sees the cells arranged in linear series, apparently in actual contiguity, in which case their lacunæ must be continuous.

The mantle is fairly strong; retractor muscle-bands only are present, and these are all evanescent before reaching the posterior end of the thorax. A sphincter musculature is present round both siphons.

The branchial sac (Plate xxv., fig.9) is remarkably long and narrow. There are eleven to thirteen rows of about twelve, long, round-ended stigmata on each side. The ciliated border cells present each a convex edge, so that the margin of the stigmata is undulating. The transverse bars are wide and not provided with membranes on the branchial aspect.

The endostyle is simple and straight.

The dorsal lamina is represented by languets equal in number to the transverse bars (Pl.xxvi., fig.4).

The tentacles are about eight in number, simple, filiform, fairly long and relatively stout.

The dorsal tubercle is of circular form, apparently with a simple aperture.

Alimentary canal (Pl. xxv., fig.9).—The œsophageal aperture forms the greater part of the posterior boundary of the pharynx. The œsophagus is thin-walled and short; it curves inwards and junctions with the oval thick-walled stomach on its inner aspect, beyond its anterior end. The wall of the stomach is neither folded nor irregularly thickened. The gut presents three distinct segments. The first, which may be regarded as the small intestine, is a short segment, with thin, somewhat folded walls, which pass backwards from the posterior end of the stomach. Following this is the thicker-walled large intestine, a somewhat longer, markedly stouter segment with quite smooth walls, which forms the posterior boundary of the abdomen, curving across from the ventral to the dorsal side and somewhat to the right. Defined from the intestine by a constriction is the rectum, which extends straight up to the right of and dorsal to the rest of the canal, and opens in the peribranchial cavity about one-third of the way up the thorax. The small anal aperture is situated at the base of a four-lobed funnel-like expansion (Pl.xxvi., fig.4).

Reproductive organs.—The testes are placed in the postabdomen. The spermatic vesicles are arranged in grape-like clusters, and from each lobe there passes a vas efferens. The vas deferens is situated on the ventral side of the postabdomen; it curves across to the opposite side along the distal edge of the large intestine, and thence it runs parallel to the rectum to terminate nearly on a level with the anus (Plate xxvi., fig. 4). The ovary is situated in the peribranchial cavity, on a level with about the middle of the thoracic portion of the rectum (Pl. xxv., fig. 9; Pl. xxvi., fig.4). The peculiarity of this situation caused some doubts as to the correctness of the observation; the specimen figured was, therefore, imbedded and sectioned; the evidence of the sections conclusively settles all doubt. A representation of a section of the ovary is shown on Plate xxvi., fig. 1. This particular ovary contains five ova of large size, two of which may be described as ripe, the others being somewhat smaller. The germinating epithelium is confined to the anterior wall, and here alone are ova of small size seen; the rest of the wall of the ovary is lined by a low cubical epithelium. The ova of largest size are invested by the flattened "test-cells," some of which may be seen within the peripheral portion of the ovum. The half-grown ovum is apparently invested by three or four layers of low cubical cells; besides this envelope of test-cells the half-grown ova are separated, one from the other, by trabeculæ of low epithelioid cells on a thin connective tissue basis, each, however, lying free in a cavity larger than itself. The stroma surrounding the youngest ova invests them closely. No oviduct is to be seen, the ripe ova being apparently set free by the rupture of the wall of the ovary.

It is of interest to note that the species is probably self-fertilising. Ova in all stages are present in the ovary, embryos in several stages of development in the peribranchial cavity

(Pl. xxvi. fig.2), and mature spermatozoa obliterate the lumen of the vas deferens.

An incubatory pouch is not present; the embryos are hatched in the peribranchial cavity.

Budding is apparently postabdominal; blind vascular diverticula of various lengths are present at the distal end of the post-abdomina of many individuals examined.

Type to be presented to the Australian Museum.

Hab.: Tamarama Bay, Sydney, New South Wales (H.L.K.). Tamarama is a small sandy bay on the ocean coast, about four miles from Sydney. Upwards of a dozen colonies of various sizes and shapes were seen attached to the sheltered sides of rocks near low-water mark, on two occasions during January, 1909.

Ciona intestinalis, var. sydneiensis Stimpson.

(Plate xxvii., figs.13-19).

Ascidia sydneiensis Stimpson, Proc. Acad. Nat. Sci. Philadelphia, vii., 1855, p. 387.

Ciona intestinalis (?) Linné, Herdman, Cat. Tunicata Aust. Mus. 1899, p. 9.

Except *Cynthia præputialis* Heller, and *Boltenia pachydermatina* Herdman, this variety of the "common European species" is the most abundant ascidian in the littoral zone of Port Jackson, Broken Bay, or Port Hacking; and, on dredging almost anywhere in Port Jackson, it comes up in great abundance, attached to seaweeds and stones.

Owing to the brevity of his descriptions, the recognition of Stimpson's species must always remain a matter of some doubt. In the present case, however, the peculiar test and description of habitat allow the local student to speak with confidence. Stimpson described six simple ascidians from Port Jackson; of these one alone is described as having a "thin often translucent test." That one is *A. sydneiensis*, the description of which applies equally well to three Port Jackson ascidians, viz., *Ciona intestinalis* (?) Linné (Herdman), *Ascidia incerta* Herdman, and

A, pyriformis Herdman. It is described as being "gregarious, several specimens growing together in one mass"; and it was "found near low-water mark, among rocks" in Port Jackson. Such is the common habit and habitat of the species here associated with the name. That Stimpson collected in a locality affected by this form, is proven for us by the fact that the Holothurian, *Synapta dolabrifera*, which he described at the same time, is very constantly found in similar situations. Finally, the other two species to which his description might apply are rare, this one is extremely common, and Stimpson's stay in Sydney was of very short duration.

The differences between var. *sydneiensis* and the typical form have already been noted by Herdman (*loc. cit.*). I incline to the view that our form should rank as a distinct species, but my European material does not permit me to make satisfactory comparisons; for that reason I append a description of the form, and content myself with drawing attention to the name which is to be applied, if that view prove correct.

External appearance.—The shape is elongate-ovate, somewhat flattened from left to right, roundly truncate posteriorly, tapering anteriorly to the siphons. The atrial siphon, when both are fully extended, is somewhat shorter, and is placed a little further back than the branchial. In preserved specimens both siphons are usually retracted to such an extent that the anterior end is abruptly truncate. In the body taken from the test (Pl. xxvii., figs. 13, 15, 16), the atrial siphon may appear the longer, the branchial being much more strongly retracted. Specimens from a sandy bottom are attached by the posterior end only, usually several together; and in such cases the tests are quite commonly completely fused. Specimens on the rocks may be attached by the posterior end only, or along the length of the dorsal side; the attachment is usually strengthened by the development of root-like processes of the test. The size and proportions are extremely variable. A large specimen will measure as much as 10 centimètres in length, with a maximum diameter of 3·3 centimètres. The largest specimens are those obtained with the dredge; they are always more flaccid than those from the tidal zone, and the body within the test is disproportionately small. The branchial aperture is eight-lobed, the atrial six-lobed, both very prominent in living specimens but completely retractile. The siphonal lobes are all ornamented towards their base with a small bright red spot. The colour of living specimens is light sea-green, preserved specimens are yellowish or grey.

The test is moderately thick, but transparent. The external layer is firm and tough, the innermost layers so gelatinous, as to be almost viscid. Test cells are of the typical stellate variety; their processes are small and few, so that they appear round or oval at first sight.

The mantle anteriorly is strong, muscular, and perfectly translucent. The opacity of the anterior end is not pronounced in living specimens; it is due to the abundance of muscular tissue which, in preserved specimens, being contracted, intensifies the opacity by puckering the mantle. The longitudinal muscle bands are external to the transverse; each arises by two thin cords from the adjacent sides of contiguous siphonal lobes (Pl. xxvii. fig. 13) on the branchial siphon. At the base of the atrial siphon these bands divide and, coursing across the left and right towards the ventral side and posteriorwards, broaden out and become evanescent before the posterior end is reached. The dorsal side and posterior end of the mantle bear transverse muscle-fibres only.

The branchial sac is delicate; its vessels of attachment, though fine, are stronger than the sac itself. There are no folds present. The transverse vessels are alternately large and small; the internal longitudinal vessels are about equal to the larger transverse in size. The meshes are broader than long, and with great constancy contain each seven stigmata. The internal longitudinal vessels bear opposite each transverse a large spatulate papilla, and along the larger transverse bars there extends a very delicate membrane. There are occasionally fine transverse bars between those already described; no papillæ are present at their intersection with the longitudinal vessels. The interstigmatic vessels are finer than the stigmata (Plate xxvii., fig.19).

The endostyle is very conspicuous; its course is very serpentine, the loops being deeper than broad.

The dorsal lamina (Pl.xxvii., fig.18) is represented by numerous long languets.

The dorsal tubercle is small, obtuse cordate, with the ends turned in (Pl. xxvii., fig.14).

The tentacles are very numerous, varying slightly in length, but without regularity.

The genital gland is situated in the intestinal loop; the vas deferens is a conspicuous object of light salmon-pink colour, attached to the rectum along its inner side. At its termination, just below the anus, there is a brilliant vermilion swelling.

The alimentary canal.—The œsophagus opens from the branchial sac far back, almost at its posterior end, and is quite a short tube. The stomach is oval in shape, placed at the extreme posterior end of the body. The gut immediately beyond the stomach curves sharply forward and slightly dorsalwards; one-third of the way up the body it again bends sharply, ventralwards and back to the posterior end; once more it turns forward, and, passing up the dorsal side, reaches to the base of the atrial siphon (Pl. xxvii., fig.17).

The specimens, from which this description is drawn, will be presented to the Australian Museum.

Ciona intestinalis var. diaphanea, Quoy & Gaimard.

Ascidia diaphanea Quoy & Gaimard, Voy. de l'Astrolabe, Zool. iii., 1835, p.612, pl.91, figs.10-11.

During April, 1903, the late Mr. Alexander Morton sent me a small collection of Tunicata dredged in Hobart Harbour. The most abundant species in the collection is that which I propose to associate with the above name. Besides this form, there is another with a diaphanous test, *Corella valentinæ* (*infra*). The identification, it must be admitted, is very doubtful; it rests on the facts that *A. diaphanea* was obtained in large numbers from moderate depths near Hobart Town, and had eight-lobed apertures, the lobes being each ornamented with a red spot. Quoy & Gaimard's figure depicts neither of these forms, nor has either of them the branchial aperture at one end and the atrial close to the other, making a right angle with the former. The form which I associate with the name is abundant, as described, has eight lobes to the branchial and six to the atrial aperture, the lobes being ornamented with pink spots. *Corella valentinæ* has seven lobes to the branchial and five to the atrial aperture; pigment spots are present between the lobes, not on them.

One is fairly safe to conclude that the French writers had one of these species, since they are both common in the locality whence theirs came; the probability is that they had both, so that, notwithstanding the discrepancies, one may confidently apply this name to one of them. I have selected the *Ciona* on the character of the branchial aperture, and the fact that it is more common than the *Corella*.

This variety differs from var. *sydneiensis* in the following characters.

The branchial sac has not the same regularity, the finer transverse bars varying in diameter; usually they are much wider than in the Port Jackson form, so that the stigmata are relatively shorter and wider. There are about eight stigmata to a mesh.

The dorsal tubercle has the arms curved rather more inwards.

Apart from these features, no difference can be detected; the characters of the branchial sacs, however, are constant in both forms and will usually serve to distinguish them.

Portion of the material which I have studied will be presented to the Australian Museum.

CORELLA VALENTINÆ, sp.nov.

(Plates xxv., figs.6-8; xxvi., fig.9; xxvii., figs.6-10).

External appearance(Pl.xxvii., figs.9-10)—Owing to the softness of the test, all the specimens are more or less distorted; apparently they were of ovoid shape, the long axis being dorsi-ventral. Both siphons are anteriorly situated nearer to the ventral than to the dorsal edge; the posterior end is flattened and was attached to a plank. Both siphons are well developed; the branchial is the larger. The branchial siphon is seven-lobed, and between the bases of the lobes are seven short brown lines. The atrial siphon is five-lobed.

The test is cartilaginous, thin and transparent, tinged green and yellow. The body within is clearly visible through the test. Test-cells are numerous; stellate (rare) and fusiform types are present. Bladder cells are present in fair abundance, but vessels and pigmented cells are absent.

The mantle is delicate, translucent, and does not adhere to the test except in the siphons. There is an irregular network of muscle-bands on the left side and anteriorly between the siphons.

The branchial sac (Pls. xxv., figs. 7-8; xxvi., fig. 9) is fairly strong and quite devoid of folds. Its general appearance is well shown in the microphotograph (Pl. xxvi., fig.9); the details are complex. The transverse vessels given off from the ventral sinus branch and anastomose to form a complex network (Pl. xxv , fig.7); all these are in one plane on the outer side of the sac. The interstigmatic vessels are spirally coiled, and the vortices are conical, their apices directed inwards. In a plane just above, within, that of these apices there is another reticulation of vessels, all of finer calibre than those of the outer network. The most regularly arranged members of this inner reticulum are transverse vessels, usually, though not constantly, equidistant. These inner transverse vessels are not arranged in any constant relation to the vortices; sometimes (Pl.xxv., fig.8) they pass on either side, at others across the centre of the vortex. The fine irregular vessels given off from these pass to the interstigmatic vessels or anastomose among themselves. The internal longitudinal vessels are quite regular in their arrangement, and are related to the inner transverse vessels exactly as depicted in the figure (Plate xxv., fig.8). The meshes of the outer reticulum may contain two, three, or even four vortices, usually only one.

The endostyle, commencing beyond the œsophageal aperture, sweeps round the sac without undulations. The circumœsophageal bands have an even curve.

The dorsal lamina (Pl. xxv., fig.6) is represented by a series of fairly stout languets placed rather far apart.

The dorsal tubercle (Pl. xxv., fig.6) is circular; the aperture is curved so as to include a cordate area; the arms are sharply turned back but do not extend beyond the area.

The tentacles (Pl. xxv., fig.6) are very numerous (about sixty), fine filiform processes fringing the branchial aperture, not long enough to meet across it.

The genital gland is situated in the intestinal loop, and, with the stomach and intestine, makes a compact visceral mass.

The alimentary canal.—The œsophageal aperture is situated at the postero-dorsal end of the sac (Pl. xxvii., fig. 6). The œsophagus is short, slender and very delicate; it leads into the wide flattened stomach. The wall of the stomach is thrown into irregular longitudinal ridges. The intestine and rectum are not defined, one from the other. The stomach and intestine lie posterior to the branchial sac, slightly to the right; the intestine is on the left hand side of the stomach. The rectum passes up nearly to the base of the atrial siphon along the dorsal edge of the body (see figs.6-7, Plate xxvii.).

Hab.—Hobart Harbour; 5 fathoms (A. Morton).

Types to be presented to the Australian Museum.

This is apparently a fairly common species; there are altogether nineteen specimens in the collection, mostly in clusters of two to four; there is also one cluster made up of four specimens of this species, and three of *Dendrodoa gregaria* Kesteven (*infra*). Since all the specimens have been squashed and distorted, it is not possible to give accurate measurements; a fairly typical example which was carefully distended gave the following dimensions. Length exclusive of siphons 2, breadth (dorso-ventral) 2-5, thickness (lateral) 1·5 cm.

The novelty is distinguished from the other members of its genus by the lobation of the siphons, and the situation of the viscera. Since both these characters necessitate a modification of the generic description, the question arose as to whether it might not be preferable to propose a new genus. In view of the fact that the number of siphonal lobes may vary within other genera (cf. *Ascidia decemplex* Sluiter) I have thought it better to adopt the present course.

This species is named for my wife.

MOLGULA MORTONI, sp.nov.

(Plates xxv., figs.4-5; xxvi., fig.8; xxvii., figs.11-12).

External appearance (Pl. xxv., fig.5).—The shape is roughly ovoid. Length 23, breadth (dorso-ventral) 27, thickness (lateral) 17·5 mm. The anterior surface is domed, its even surface being broken by the prominences on which the apertures are situated, and by a ridge between these. The left side and the two ends are evenly convex, the right side is flattened; it was attached to a plank by this side. The colour is a dark grey passing into dusky tan in the neighbourhood of the siphons, and on the ridge between them. The branchial aperture is six-, the atrial four-lobed.

The test is moderately thin but comparatively opaque, and leathery; on the inner side it is white and has a satin sheen. The external surface is devoid of processes and sand-grains, and, but for very small closely placed pustules on the siphonal areas, is smooth or only slightly wrinkled. Test-cells are very numerous; they are of elongate-fusiform shape. Around the widely separated vessels are clustered cells of irregular shapes which are possibly phagocytes. The ectoderm adheres to the test, and comes away in patches attached to its inner side. Peculiar cell-clusters, resembling solid morula embryos, are also present in the test.

The mantle is strong and opaque, its opacity being largely due to the presence of a black pigment. Muscle-fibres are present in abundance arranged quite irregularly, no definite bands being formed. The alimentary canal and gonads are deeply imbedded in the mantle, and therefore visible through it (Pl. xxvii., fig 11).

The branchial sac (Pl. xxvi., fig.8) bears seven strong folds on either side, whose relation to endostyle, dorsal lamina, and the two apertures, is shown diagrammatically by fig.12, Pl.xxvii. The irregularity of the transverse and interstigmatic vessels makes it difficult to describe the mantle in detail. Each fold bears four or five internal longitudinal vessels, and there are either three or four in the interspaces; these latter are finer than those on the folds, and are close together beneath the folds; in the preparation photographed (Pl.xxvi., fig.8) they have been brought into view by cutting away a fold. The arrangement of transverse and interstigmatic vessels is almost regular and rectangular on the folds, but is very irregular in the interspaces; true vortices are rare; only one is shown in the microphotograph at the top.

The endostyle extends from the dorsal end of the sac to the circumœsophageal bands without undulation. The circumœsophageal bands have a very undulatory course (Pl.xxv., fig.4).

The dorsal lamina (Pl.xxv., fig.4) is a simple membrane, not ribbed or toothed. Owing to the approximation of œsophageal and branchial apertures, the lamina is short; apparently it does not extend beyond the former aperture dorsally.

The dorsal tubercle (Pl. xxv., fig.4) is somewhat rhomboid in outline, with well rounded corners. The aperture upon it is sigmoid, each arm ending against an oval opaque-white area. The lips of the aperture are opaque-white, due to the closely packed cilliated cells lining it; and the two areas at the ends of the arms are apparently ovoid chambers, probably similarly lined.

The tentacles are about sixteen or twenty in number, they are arched over and completely close the branchial aperture. Each tentacle consists of a stout tapering rachis about 3 millimètres long, and 0·3 of a millimetre broad at its base, bearing on either side a series of pinnæ, which in turn bear pinnules; the pinnæ of the base are scarcely longer than those of the apex; their pinnules may bear secondary pinnules. The length of the central rachis varies slightly, but without regularity.

The genital glands are situated on either side of the body; that on the left side is in two portions, one of which is situated in the rectal loop, the other posterior to the intestine (Pl. xxvii., fig.11). The second gland is situated in the middle of the right side; all are attached to the mantle.

Alimentary canal. — The œsophageal aperture is situated anteriorly almost directly beneath the atrial siphon, and close to the branchial aperture; from here the gut passes posteriorly and ventrally along the left side; sweeping round anteriorly again, it turns abruptly back on its course and returns to its starting point parallel and close to itself, so that the intestinal loop is very narrow. There are no macroscopic features indicating the various regions of the gut (Pl.xxvii., fig.11).

Hab.—Hobart Harbour, dredged 5-11 fathoms (A. Morton.)

Type to be presented to the Australian Museum.

The novelty is named for the late Mr. Alexander Morton, who collected and presented it to me.

This *Molgula* is of typical shape, but is atypical in the absence of sand-grains and processes of the test, and also in being attached. The branchial sac, in its regularity on the folds and rarity of vortices, presents an intermediate condition towards *Ascopera*.

Dendrodoa gregaria, sp.nov.

(Plates xxv., figs.1-3; xxvi., fig.7; xxvii., figs.1-5).

External appearance.—The shape is extremely variable. Both apertures are anteriorly situated, on more or less prominent pustulose areas; both are four-lobed. The most prevalent form is that repsesented in outline by figure 3, Plate xxvii., roughly pyramidal, the apex being the branchial siphon; on the other hand that contour may be turned upside down, as it were, as represented by figure 4; other individuals are roughly quadrangular (fig. 1) or globular. The colour is dull grey in exposed parts, dusky tan round and between the siphons; and in specimens growing in clusters, the contiguous portions are silvery white. The resemblance between this species and *Molgula mortoni* is very close, the latter differing only in being more globular.

The test, in macroscopic features, resembles that of *M. mortoni*, differing only in being a little thicker. Test-cells are very numerous, ovoid and fusiform, the former much the more abundant; stellate cells are not present. Phagocytes (?) are also numerous, spherical or spherical-crenated without vacuoles, or irregularly distended by vacuoles. The ectoderm adheres closely to the test, and a thin strip taken at random from the inside always bears several patches. The phagocytes (?) take a darker stain than the squames of the epithelium, and may be *clearly* seen among them, as well as throughout the test. Large bladder-cells are present, and some of these certainly have the appearance of being filled with smaller cells. Typical vessels are not well developed, and one of the preparations made shows the presence of peculiar branched vessels of small lumina, and lined by high columnar epithelium.

The mantle is strong and semitransparent; it adheres very closely to the test. Fine retractor bands are developed round both siphons (Pl.xxvii., fig.1), and muscle-fibres are matted throughout the whole mantle.

The branchial sac (Pl. xxvi., fig.7) is weak though fairly thick, and is difficult to detach from the mantle intact. There are four strong folds on either side; their relation to endostyle, dorsal lamina and the two apertures is shown diagrammatically in fig. 5, Plate xxvii. The rear ethree internal longitudinal vessels in the interspaces, four on the sides and one on the crest of each fold. Transverse vessels are of very various sizes (Pl. xxvi., fig.7) and irregular arrangement. Where most regularly arranged, three sizes can be recognised; between each pair of the largest, are three of medium size, and alternating with them are those of the smallest size. In places these last are represented by anastomoses of the interstigmatic vessels, rather than by definite vessels, and in other places are not developed at all. Occasionally the interstigmatic vessels are very much enlarged; such enlarged vessels may extend across three or four meshes. Fine membranes are present along a few of the transverse vessels. There are about twelve stigmata to a mesh near the base of the folds, and about six on either side of the crest. On either side of the endostyle the meshes are very broad and contain upwards of twenty-five stigmata. The interstigmatic vessels are rather finer than the stigmata.

The endostyle extends from just dorsal to the œsophageal aperture, round the sac without undulation to near the circum-œsophageal bands, where it presents a deep double loop (Pl. xxvii., fig.5). The circumœsophageal bands have an even curve without undulations.

The dorsal lamina is a plain undulating membrane, devoid of teeth and ribs.

The dorsal tubercle (Pl. xxv., fig.3) is oval in outline, the longer axis being transverse. The aperture is curved so as to include a somewhat cordate area. The subneural gland is a pyriform body lying beneath the nerve.

The tentacles are numerous (Pl. xxv., fig.3), simple filiform processes. Two grades of size are distinguishable; the larger are about twenty in number, those of smaller size about twice as numerous. Their arrangement is quite irregular, and intermediate sizes are present.

The genital gland is in the form of a large number of small lobes attached to the mantle on the right side (Pl. xxvii., fig.1).

The alimentary canal is divided into regions clearly recognisable from changes in colour or size, The situation of the various parts is shown in outline by figure 2, Plate xxvii. The œsophagus is a short slender tube, very delicate and of a dull grey colour; its lumen is triradiate in cross-section. The stomach (Pl. xxv., fig.2) is oval in shape, yellow in colour, and bears numerous oblique folds, which extend from a smooth area, along the centre of the left side, backwards and to the right side. The intestine is yellow in colour; and the rectum, which commences on the intestinal loop, is dark green. The intestinal loop is neither wide nor narrow, but intermediate.

Hab.—Hobart Harbour; 5 fathoms (A. Morton).

D. gregaria is apparently a common form ; there are upwards of thirty specimens in the collection; they were attached by the posterior end; clumps of three or four are common, but there is no tendency to fusion of the tests.

Types to be presented to the Australian Museum.

Dendrodoa gregaria is apparently very like *Styela radicosa* Herdman, from which it differs in having no root-like processes to the test, and in the number of internal longitudinal vessels on fold and interspace in the mantle, as well as in the character and situation of the gonads; that is, if the generic name applied by Herdman may be taken for a description of his species.

Herdman* has expressed the opinion that *Dendrodoa* "should be merged in *Styela*"; the present species, however, has the genital gland in the form characteristic of *Polycarpa.* If *D. glandaria* MacLeay, is to be regarded as a *Stylea*, then *D. gregaria* Kestv., must be placed in the genus *Polycarpa.*

All of the Hobart material discussed in this paper was obtained by the late Mr. Morton, attached to a large wooden box raised from a depth of 5 fathoms. Since upwards of one hundred specimens were so obtained, the abundance of Tunicata in Hobart Harbour must be very great.

In concluding, I wish to thank Professor Anderson Stuart, in whose laboratory this work has been done.

EXPLANATION OF PLATES XXV.-XXVII.

Abbreviations.

A., anus—Atr. Ap., atrial aperture—Br. Ap., branchial aperture—D. L., dorsal lamina, or dorsal languets—End., endostyle—Emb., tailed larvæ—Flds., branchial folds—G., subneural gland—Gon., gonad—N.G., nerve ganglion—Oes., œsophagus—Ov., ovary—R., rectum—St., stomach—T., tubercular diverticulum of the cloacal chamber—V.D., vas deferens.

The outlines in every case were obtained with camera lucida or reflecting prism.

Plate xxv.

Fig. 1.—*Dendrodoa gregaria* Kestv.; seen from above.
Fig. 2.— ,, ,, ,, stomach.
Fig. 3.— ,, ,, ,, dorsal tubercle and related parts.
Fig. 4.—*Molgula mortoni* Kestv.; dorsal tubercle and related parts, seen from above.
Fig. 5.—*Molgula mortoni* Kestv.; complete specimen, seen from above.
Fig. 6.—*Corella valentinæ* Kestv.; dorsal tubercle and related parts.
Fig. 7.— ,, ,, branchial wall, atrial aspect.
Fig. 8.— ,, ,, ,, ,, branchial aspect; diagrammatic.
Fig. 9.—*Sidneioides tamaramæ* Kestv.; a single zooid.

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* Challenger Report, Tunicata, Pt. i., p. 148.

Plate xxvi.

Fig. 1.—*Sidneioides tamaramæ* Kestv.; section of ovary.
Fig. 2.— ,, ,, ,, anterior end of zooid.
Fig. 3.— ,, ,, ,, a test-cell.
Fig. 4.— ,, ,, ,, portion of thorax.
Fig. 5.— ,, ,, ,, colony from above.
Fig. 6.— ,, ,, ,, portion of a colony, from the side.
Fig. 7.—*Dendrodoa gregaria* Kestv.; branchial wall.
Fig. 8.—*Molgula mortoni* Kestv.; branchial wall.
Fig. 9.—*Corella valentinæ* Kestv.; branchial wall.

Fig. 1 is reproduced from a drawing on a faint bromide print, from a microphotograph which, together with figs. 5, 6, 7, 8 and 9, were taken for me by Mr. Louis Schaeffer, of the Anatomy Department.

Plate xxvii.

Fig. 1.—*Dendrodoa gregaria* Kestv.; outline of body removed from the test, seen from the right.
Fig. 2.— ,, ,, ,, outline of body removed from the test, seen from the left.
Fig. 3.— ,, ,, ,, outline of complete specimen.
Fig. 4.— ,, ,, ,, outline of complete specimen.
Fig. 5.— ,, ,, ,, half branchial sac, from within.
Fig. 6.—*Corella valentinæ* Kestv.; showing the situations of the parts seen in and through the branchial wall.
Fig. 7.— ,, ,, ,, body removed from the test, dorsal aspect.
Fig. 8.— ,, ,, ,, body removed from the test, ventral aspect.
Fig. 9.— ,, ,, ,, complete specimen.
Fig. 10.— ,, ,, ,, complete specimen.
Fig. 11.—*Molgula mortoni* Kestv.; body removed from the test, seen from the left.
Fig. 12.— ,, ,, ,, half branchial sac, seen from within.
Fig. 13.—*Ciona intestinalis* Linn., var. *sidneiensis* Stimpson; anterior end of body removed from the test, seen from the left.
Fig. 14.—*Ciona intestinalis* Linn., var. *sidneiensis* Stimpson; dorsal tubercle and related parts.
Fig. 15.—*Ciona intestinalis* Linn., var. *sidneiensis* Stimpson; body removed from the test, seen from the right.
Fig. 16.—*Ciona intestinalis* Linn., var. *sidneiensis* Stimpson; body removed from the test, seen from the left.
Fig. 17.—*Ciona intestinalis* Linn., var. *sidneiensis* Stimpson; diagrammatic outline showing situations of gonad, vas deferens and alimentary canal.
Fig. 18.—*Ciona intestinalis* Linn., var. *sidneiensis* Stimpson; dorsal languets.
Fig. 19.—*Ciona intestinalis* Linn., var. *sidneiensis* Stimpson; branchial wall.

SECOND SUPPLEMENT TO THE "REVISION OF THE CICINDELIDÆ OF AUSTRALIA."

By Thomas G. Sloane.

Genus Megacephala.

Megacephala bostocki Castelnau.

Attention may be directed to the fact that Dr. Walther Horn has recently authoritatively published the synonymy of *M. excisilatera* Sloane, with *M. bostocki* Castelnau, after inspection of the type of Castelnau's species.*

Megacephala hopei Castelnau.

This species has been confused with *M. scapularis* Macl.,(which is considered by Dr. W. Horn to be a colour-variety of *M. australasiæ* Hope) but is quite distinct. It differs from *M. scapularis* Macl., by the basal part of pronotum, including the impressions on both sides, being smooth (not tuberculate or rugulose); elytra punctate, as usual in the genus (not in wavy lines as in *M. australasiæ*); puncturation of basal part stronger, &c. The yellow margin is broad at the apex and on the posterior part of the sides, but becomes narrow anteriorly, and does not reach the shoulder.†

I am indebted to Dr. Walther Hall, of Berlin, for a specimen ticketed as "*M. hopei* Cast., *sec. typus*; Nickol Bay." I have not seen it in any Australian collection; and I have placed it in the Macleay Museum for reference.

The position of *M. hopei* in the genus is next to *M. australasiæ* Hope.

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* Deutsche Ent. Zeit. 1909, p.164.

† Dr. W. Horn has given figures of the elytral pattern of *M. hopei* and *M. scapularis* in Wytsman's "Genera Insectorum" 82A Fascicule, Subfam. *Cicindelinæ*, p.29.

Genus Distypsidera.

Distypsidera volitans Macleay, var. obscura, var.nov.

In my "Revision" (These Proceedings, 1906, p.334), I placed under *D. gruti* Pascoe, as "Var.?A", a species of *Distypsidera* from the neighbourhood of Cairns. Subsequently I received, from Mr. F. P. Dodd, more specimens of this form, taken by him in the open forest country inland from Cairns (Mareeba and Mount Garnet). An examination of the specimens sent by Mr. Dodd shows that this form is actually more nearly allied to *D. volitans* than to *D. gruti*. It must be considered probably to be a variety of *D. volitans* rather than a distinct species. I can differentiate it from *D. volitans* only by its wanting the whitish apical spots of the elytra. It may be differentiated from *D. gruti* by the pronotum less convex, more opaque, more closely and strongly transversely rugose, lateral borders more strongly developed; and by the elytral sculpture. In *D. gruti* the posthumeral white stripe becomes wider backwards, and bears few, if any, punctures; and the sculpture between this stripe and the suture is undulate-plicate; in *D. volitans* and var. *obscura* the posthumeral stripe, if present, does not become wider backwards, and its course is as coarsely punctate as the adjoining parts of the elytra, the space between this stripe and the suture being coarsely punctate, and hardly undulate-plicate. In *D. gruti* there is normally a juxta-scutellar white spot, but in *D. volitans* and var. *obscura* the base is never maculate near the scutellum. The male of *D. volitans* and var. *obscura* differs from that of *D. gruti* by having the penis hooked at the apex. Length 12-14 mm.

Genus Cicindela.

In my "Revision," p.328, I have said of the labrum: "In the Distypsidera-like form the setæ are marginal, a seta being found in every notch between the teeth." This is erroneous; in the *Cicindelæ spuriæ* of my "Revision" the labrum bears only four *tactile marginal setæ*—the first in the deep notch on each side of the apex; the others, one on each side, in the hindmost lateral notch. The position of these setæ is shown in Mr. Lea's figure of the labrum of *C. tenuicollis* Macl. (These Proceedings, 1906, Pl. xxx., fig 105).

CICINDELA SCITULA, n.sp.

♂. Labrum short, with four submarginal tactile setæ. Mentum with median tooth long, acute. Labial palpi slender, apical joint long. Prothorax encircled by a deep anterior impression; pronotum convex, glabrous. Elytra convex, strongly and coarsely punctate. Proepisterna sparsely setigero-punctate near coxæ; meso- and metepisterna, also ventral segments, glabrous. Posterior coxæ with a fringe of white hair above declivity of outer side. Metepimera with a strong foveiform concavity. Æneous, prothorax greener than elytra; labrum pale, infuscate on margin, setigerous punctures green at bottom; each elytron with two white lateral spots—the anterior very small, a little behind the middle of the length, at about one-fourth the breadth of elytron; the posterior a little behind outer angle of apical curve; head æneous-green, gulæ blue; under thoracic parts metallic green, abdomen tending to chalybeous; femora metallic green with cupreous reflections towards apex; tarsi and tibiæ (towards apex) blue.

Head (2.15 mm. across eyes) with interocular part deeply concave, transversely rugulose in middle, longitudinally striolate near eyes; eyes large, prominent. Labrum with anterior margin lightly advanced in middle (in front of the two inner submarginal setæ), the prominent median part lightly bisinuate. Prothorax broader than long (1·5 x 1·7 mm.), shining; disc faintly rugulose; anterior margin lightly and roundly advanced in middle; anterior transverse impression very deep; posterior transverse impression deep, narrow near base; sides rounded between transverse impressions. Elytra oval, much wider than prothorax (4·7 x 2·5 mm.), convex; puncturation close and coarse; sutural apical mucro very short. Length 8, breadth 2·5 mm.

Hab.—Northern Territory. A single specimen was given to me by Mr. C. French, as coming from the Pine Creek District, N.T.

A very distinct species having the facies and punctate elytra of a member of the *C. tenuicollis*-group, but belonging to the *C. nigrina*-group by form of labrum; mesosternum, and metasternum glabrous; labial palpi slender; median tooth of mentum long, &c.

CICINDELA DARWINI, n.sp.

Labrum short, with four submarginal tactile setæ. Mentum with median tooth long. Labial palpi slender, apical joint long. Prothorax and elytra subdepressed; pronotum glabrous. Elytra glabrous, apex in ♀ excised, and with a strong sutural spine; in ♂ not excised, and with short sutural mucro. Head, mesosternum and metasternum glabrous. Proepisterna sparsely beset with setigerous punctures. Posterior coxæ with a fringe of white hair above declivity of outer side. Upper surface cupreous-green or bronze; elytra 3-maculate on each side—an elongate narrow humeral lunule, a small median spot, and a narrow apical lunule yellowish; under surface shining, cupreous with coppery and greenish reflections; legs cupreous, tarsi purple; antennæ with four basal joints bronzy, other joints infuscate; labrum of a dirty yellowish colour; mandibles bronzy-green, yellowish near base, black at apex.

Head (2·25 mm. across eyes) closely and decidedly shagreened, very lightly concave between eyes. Labrum short, with four submarginal punctures rising from greenish punctures (one near each outer angle, and two near one another in middle, as in *C. nigrina* Macl.); anterior margin in ♂ lightly arcuate, in ♀ strongly advanced in middle, with a well marked tooth on each side of median prolongation, the distance between the teeth slightly greater than that between the inner submarginal setæ. Prothorax subquadrate (1·75 × 2 mm.); disc depressed, strongly and closely shagreened, lightly transversely impressed anteriorly and posteriorly; sides lightly arcuate; posterior angles distant from basal margin—in ♂ obtuse and hardly marked, in ♀ obtuse but decidedly marked. Elytra subdepressed (5·2 × 2·75 mm.), much wider at base than prothorax; sides subparallel; apical curve serrate. Length, ♂ 8, breadth 2·75 mm.

Hab.—Port Darwin (Dodd). Colls. Sloane and Horn.

An isolated and very interesting species which I place in the *C. nigrina*-group.* It seems to indicate some ancient affinity between the *C. nigrina*- and *C. tetragramma*-groups.

The *C. nigrina*-group may be tabulated thus:—

Form convex. Pronotum strongly transversely impressed anteriorly and posteriorly; disc convex, smooth (a little wrinkled). Elytra coarsely punctate.

Colour dark bronze, elytra nigrescent. Elytral puncturation formed by separate round pits becoming finer towards apex. Size 10 mm. *C. nigrina* Macleay.

Elytra æneous. Elytral puncturation coarse, close, strong to apex. Size 8 mm... ....*C. scitula* Sloane.

Form depressed. Pronotum lightly transversely impressed anteriorly and posteriorly, surface coarsely shagreened. Elytra closely but not coarsely punctate.......................................*C. darwini* Sloane.

Cicindela queenslandica, n.sp.

♀. Allied to *C. tetragramma* Boisduval, ♀. Oval, convex; sternal side-pieces and posterior coxæ glabrous. Head and prothorax bronzy with green tints; elytra metallic green, with wide lateral and apical border, and two discoidal plagæ on posterior two-thirds lacteous; labrum and basal part of mandibles lacteous; mesosternum, metasternum and basal ventral segments bronze with greenish reflections; prosternum (including episterna) metallic cupreous-bronze; palpi pallid, with apex of apical joints dark metallic green; penultimate joint of labial palpi and base of maxillæ with long white hair; antennæ long, four basal joints metallic green with cupreous reflections, other joints infuscate; posterior coxæ and abdomen fiery cupreous, four anterior coxæ green with a white pilosity; trochanters testaceous; femora green (testaceous towards apex), with long white hairs on basal half; tibiæ and tarsi green, four anterior tibiæ thickly hirsute towards apex, except on anterior side, posterior tibiæ sparsely setose.

Head wide (3·4 mm. across eyes), shagreened, longitudinally rugulose and lightly concave between eyes. Labrum with a

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* Dr. W. Horn, of Berlin, informs me that "*C darwini* is a typical member of the *C. nivicincta-limosa*-group." This Indo-Malayan group is now recorded for the first time as having an Australian representative.

transverse row of six submarginal punctures; anterior margin arcuate on each side, a small obtuse triangular prominence in middle. Prothorax roughly shagreened, depressed, broader than long (2·25 × 2·85 mm.), narrower at apex (2·15 mm.) than at base (2·75 mm. at posterior angles), constricted by an arched impression near anterior margin; a light wide transverse impression near base; posterior angles obtuse, but distant from basal margin. Elytra oval (9 × 5 mm.), convex, punctate (the green part coarsely, the whitish parts finely punctate); humeral impression well marked, wide; apical curve roundly, widely, and lightly emarginate in middle; suture ending in a short mucro. Length 12·7, breadth 5 mm.

Hab.—Queensland, Cairns ("A. Anderson, on sea-beach"). Sent to me by Mr. A. M. Lea.

The largest Australian species of the genus *Cicindela*; it is allied to *C. albolineata* Macl., and *C. trivittata* Macl.; from both of which (also from *C. tetragramma* Boisd.) it differs by the pattern of the elytra; less prominent posterior angles of prothorax, &c.

Cicindela mastersi, Castelnau.

Mr. F. P. Dodd sent me specimens of a Cicindela taken by him inland from Cairns (open forest country about Mareeba, Mount Garnet, &c.) which has the elytral pattern of *C. mastersi* (though a little more reduced, and without any humeral white spot in either sex). It is conspecific with *C. plebeia* Sl., and indicates that *C. plebeia* was described from a dark form, probably peculiar to the heavily timbered coastal districts of North Queensland.

A comparison of Mr. Dodd's inland specimens mentioned above, with *C. curvicollis* Sl., (a synonym of *C. catoptriola* Horn), from North-West Australia compels me to consider them conspecific, so that I have now no objection to urge against Dr. Horn's view, that this smaller tropical form is a variety of *C. mastersi*.* I would, therefore, catalogue it as *C. mastersi* Castelnau, var. *catoptriola* Horn,=*C. plebeia* Sloane.

* *Cf.* These Proceedings, 1906, p.347.

THE HEXONE BASES OF EGG-WHITE.

By J. M. Petrie, D.Sc., F.I.C., Linnean Macleay Fellow of the Society in Biochemistry; and H. G. Chapman, M.D., B.S.

(*From the Physiological Laboratory of the University of Sydney*).

The separation of the hexone bases from the products of the hydrolysis of the proteins of egg-white dates from the work of Siegfried*, communicated by Drechsel†. In 1895, Hedin‡ separated 2·4 gm. arginin from 300 gm. Albumin aus Eiweiss (Grubler), a yield of 0·8%. In 1896, Hedin recognised lysin§, and, a little later, histidin‖ among the products of the dissociation of the same substance.

In 1899, Hausmann¶ determined the amount of diamino nitrogen in egg-albumin prepared by the method of Hofmeister. His figure represents that portion of nitrogen which is precipitable by phosphotungstic acid after the ammonia has been removed by boiling with magnesia. The hydrolysis was carried out with boiling hydrochloric acid. Hausmann found 21·33% of the

* Ber. xxiv., S. 418, 1891.
† Arch. Anat. u. Phys., S. 271, 1891.
‡ Zeit. physiol. Chem., xxi., S. 163, 1895 6.
§ Zeit. physiol. Chem., xxi., S. 302, 1895-6.
‖ Zeit. physiol. Chem., xxii., S. 191, 1896-7.
¶ Zeit. physiol. Chem., xxvii., S. 95, 1899.

nitrogen precipitable under the conditions of the experiment. This amounted to 3·31% of the weight of the egg-albumin. Kutscher*, who carried out similar determinations, found 27% of the nitrogen present as diamino nitrogen in Eieralbumin free from globulin and ovomucoid. This represented 4·19% of the weight of the albumin. Osborne and Harris† found the basic, *i.e.*, the diamino nitrogen to be 3·3% of the weight of ovalbumin, and 4·16% of the weight of conalbumin, both prepared from hens' eggs. Osborne, Leavenworth, and Brautlecht‡ determined the quantities of the individual hexone bases arginin, histidin, and lysin in ovalbumin and conalbumin. They state that the amount of nitrogen contained in these bases corresponds closely with that precipitated by phosphotungstic acid. They therefore consider that determination of nitrogen precipitated by phosphotungstic acid furnishes a valuable means for controlling the results of base determinations in proteins.

Hugounenq and Galimard§ found 2·5% lysin, 2·14%arginin, and no histidin in the ovalbumin of hen's egg.

Scope of investigation.—The amounts of arginin, histidin, and lysin have been estimated in the products of the hydrolysis of hen's egg-white. The whole egg-white, rather than any separated purified protein, has been employed since egg-white is used for experimental work in nutrition and not purified protein. The isolation of chemically pure proteins from egg-white is difficult, and it is doubtful whether the methods of separation for pure proteins are as yet satisfactory.‖ It is also not proven that the separate proteins of egg-white are bodies of constant and definite constitution.

In certain preliminary attempts the hydrolysis has been performed with 5% sulphuric acid, and, also (by one of us, H.G.C.),

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* Zeit. physiol. Chem., xxxi., S. 215, 1901.

† Journ. Amer. Chem. Soc., xxv., p. 346, 1903.

‡ Amer. Journ. Physiol., xxiii., p. 194, 1908.

§ C.R., T. 143, p. 242, 1906.

‖ Compare Mellanby, Journ. of Physiol., xxxvi., p. 288, 1907.

with pancreatic juice, obtained by the injection of secretin into a dog and activated by enterokinase. These hydrolyses were incomplete, though continued for many hours. A complete hydrolysis has been accomplished with 25% sulphuric acid.

Methods.—The methods of separation devised by Kossel and Kutscher*, with the modifications of Kossel and Patten† and Osborne, Leavenworth and Brautlecht,‡ have been employed. In four out of the five determinations, the hexone bases were first precipitated by phosphotungstic acid.

Hydrolysis.—In the final experiment, 680 c.c. egg-white containing 95·7 gm. solid matter, 89·6 gm. protein, and 12·32 gm. nitrogen were placed in a steam sterilizer at 100°C., with 150 c.c. water and 50 c.c. sulphuric acid, for 7 hours. Then 200 c.c. sulphuric acid were added, and the mixture steamed for 6 hours. It was now heated to the boiling point on a sand-bath with a a reflux condenser, for 69 hours. The volume was made up to 1 litre, and 10 c.c. were removed for the estimation of amide ammonia and melanoidin nitrogen§. The results gave 1·05 gm. nitrogen as ammonia, and 0·224 gm. nitrogen as melanoidin. Previously attempts had been made to carry out the hydrolysis with 5% sulphuric acid. Thus 39·25 gm. dried egg-white (250c.c.) were boiled in 500 c.c. 5% sulphuric acid for 50 hours. The biuret test was positive after 25 hours' ebullition, but at the end it appeared to be negative. Two other experiments, one continued for 17 hours, and the other for 48 hours, were carried out. In these, and also in the tryptic digest the amounts of hexone bases were much too small, while the percentage of nitrogen precipitated by phosphotungstic acid was too large||. Certain of the final products were contaminated with bodies resembling the

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* Zeit. physiol. Chem., xxxi., S.165, 1901.

† Zeit. physiol. Chem., xxxviii., S.39, 1903.

‡ *Loc. cit.*

§ Osborne and Harris, *loc. cit.*

|| Nitrogen present as ammonia was expelled before the estimations were made.

dipeptide isolated by Levene and Beatty*. Corroboration was thus obtained of the difficulty in completing the hydrolysis of certain proteins, as noted by Osborne, Leavenworth, and Brautlecht.

Separation of hexone bases by phosphotungstic acid.—The filtered digest was diluted to contain 5 % sulphuric acid. Phosphotungstic acid was added until the 5 litres contained about 5 % reagent. The precipitate that fell, on the further addition of phosphotungstic acid, consisted only of reagent. After standing 72 hours the superfluid was decanted, and the remaining portion separated in the centrifuge. All the separations, with the subsequent washing of precipitates, have been done in the centrifuge. Much labour and time are saved in this way. Many precipitates are driven down hard by 10 minutes' spinning, so that the superfluid can be poured off. Three or four washings then suffice, as the hard, practically dry mass can be suspended in water and thoroughly mixed or heated as required. The solid matter is again separated in the centrifuge.

Separation of arginin from histidin.—The separation of arginin from histidin was, in our hands, difficult. This was probably due to inexperience, as an improvement was noted in each subsequent hydrolysis. It was invariably found that much arginin was precipitated with the histidin in the second silver precipitation of Kossel and Kutscher. This was obvious upon applying Kossel and Patten's process to the histidin portion. Nitrogen determinations showed the presence of a quantity of arginin in the filtrate from mercuric sulphate. Further, it seemed that the mercuric sulphate did not completely precipitate histidin, as frequently four or five precipitates containing histidin separated from the filtrate, if this was allowed to stand two or three weeks.

On employing the precipitation by mercuric sulphate of Kossel & Patten previous to the second silver precipitation of Kossel & Kutscher, as suggested by Osborne, Leavenworth and Brautlecht, no difficulty was experienced in the separation.

* Biochem. Zeitsch. iv., S. 299, 1907.

Estimation of the separated hexone bases.—Two methods have been employed. In the first method the amount of nitrogen present in the final solution is estimated, and the quantity of base calculated from this figure. The bases are isolated as salts only for identification. In the second method the isolated salts are used to calculate the weight of bases.

While little can be said against the practice of calculating the weight of base present in the "purified" fluids from which the salts are crystallised, there is more doubt concerning another practice recently introduced. Jackson and Pearce* estimated the total hexone base from the amount of nitrogen precipitated by phosphotungstic acid, the arginin and histidin from the nitrogen precipitated by silver nitrate and baryta, and the lysin from the nitrogen in the filtrate freed from silver and baryta. Siegfried and Pilz† adopted a somewhat similar practice. The results recorded from our experiments in Table i., show that both these portions (histidin plus arginin, and lysin) contain nitrogen not attributable to these substances.

Results.—A record of two of our experiments is given in Table i. The amounts of nitrogen obtained at the various stages of the separation are stated. The first hydrolysis was performed with 5 % sulphuric acid for 17 hours, and the second with 25 % sulphuric acid for 69 hours. The first separation was conducted according to Kossel & Patten, the second by the modification of Osborne, Leavenworth & Brautlecht. In each case the precipitation with silver and baryta was repeated to throw down completely the arginin.

The percentage of total nitrogen present in each stage enables the two results to be compared. The high figure in the first hydrolysis for the precipitate with phosphotungstic acid (30·5 %) is due to the precipitation of polypeptides. This was evidenced also by the separation with the lysin of the body resembling the

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* Journ. Expt. Med., ix., p.520, 1907.
† Zeit. physiol. Chem., lviii., S.224, 1908.

TABLE I.

	Hydrolysis I.		Hydrolysis II.	
	Nitrogen.	% of total Nitrogen.	Nitrogen.	% of total Nitrogen.
Nitrogen in hydrolysed fluid	2·15 gm.	100·00	12·32 gm.	100·00
Nitrogen as ammonia			1·05	8·52
Nitrogen as melanoidin			0·224	1·82
Nitrogen precipitated by phosphotungstic acid after removal of ammonia	0·656	30·50	2·14	17·36
Nitrogen precipitated by silver and baryta	0·238	11·07	1·045	8·48
Nitrogen in filtrate from silver and baryta (by difference)	0·418	19·43	1·095	8·88
Nitrogen in filtrate from silver and baryta, pptd. by phosphotungstic acid; this gives nitrogen as lysin...	0·147 (0·054)*	6·84 (2·51)	0·548	4·45
Nitrogen in the histidin portion	0·0293	1·37	0·16	1·30
Nitrogen in the arginin portion	0·117	5·44	0·685	5·56
Nitrogen pptd. by silver and baryta and not pptd. as histidin or arginin	0·038†	1·77	0·20†	1·62
Nitrogen in the filtrate from silver and baryta and not pptd. by phosphotungstic acid	—	—	0·19†	1·55

* Calculated from the separated lysin picrate.
† Amount actually estimated, the remainder unaccounted for.

dipeptide of Levene & Beatty.* Owing to this admixture the lysin nitrogen was calculated from the lysin picrate as 0·054 gm., and not from the nitrogen precipitated by the phosphotungstic acid, viz., 0·147 gm.

On the other hand, 17·36 % in the second hydrolysis is a low figure, since the method of Hausmann gives 21·33 %. Our low figure is due to the incomplete washing of the precipitate of barium sulphate and phosphotungstate.

The figures of histidin and arginin agree well. It must be pointed out that a considerable loss of nitrogen occurred with each precipitate of barium sulphate, with the result that the nitrogen figures do not add up. Thus, in experiment ii., 0·548 gm. nitrogen as lysin plus 0·19 gm. other than lysin, or 0·74 gm. nitrogen were obtained from 1·095 gm. nitrogen present originally.

The protein in the second hydrolysis amounted to 89·6 gm. The lysin calculated from the nitrogen present in the solution from which the lysin picrate was precipitated was 2·86 gm. The lysin picrate once recrystallized weighed 5·47 gm.

0·133 gm. lysin picrate gave 17·5 c.c. $\frac{N}{10}$ NH_3 by Kjeldahl-Jodlbauer-Gunning method.

$C_6H_{14}N_2O_2.C_6H_2(NO_2)_3OH$ requires 18·66 % N. Found 18·42 % N.

The solution of histidin contained nitrogen equal to 0·59 gm. histidin. There was crystallized 0·25 gm. histidin dichloride and 0·484 gm. picrolonate.

0·0618 gm. histidin dichloride gave 0·0762 gm. AgCl.

$C_6H_9N_3O_2.2HCl$ requires 31·18 % Cl. Found 30 5 % Cl.

It was noted that the histidin dichloride gave a slight residue of barium salt upon combustion.

The solution of arginin contained nitrogen equivalent to 2·14 gm. arginin. A portion was lost, but from a fraction containing 0·433 gm. nitrogen, 2·437 gm. arginin nitrate were obtained. The arginin nitrate was converted into arginin copper nitrate.

* *Loc. cit.*

0 219 gm. arginin copper nitrate gave 0·02372 gm. Cu.

$(C_6H_{14}N_4O_2)_2.Cu(NO_3)_2.3H_2O$ requires 10·79% Cu. Found 10·83%.

0·219 gm. arginin copper nitrate gave 0·020 gm. H_2O.

$C_6H_{14}N_4O_2)_2.Cu(NO_3)_2.3H_2O$ requires 9·16% H_2O. Found 9·14%.

The amounts of lysin, histidin, and arginin present in 100 gm. protein of egg-white are therefore—

Lysin	...	3·19%
Histidin	...	0·66%
Arginin	...	2·39%

In conclusion, we express our thanks to Professor Anderson Stuart, in whose laboratory this investigation was conducted.

NOTES ON THE NATIVE FLORA OF NEW SOUTH WALES.

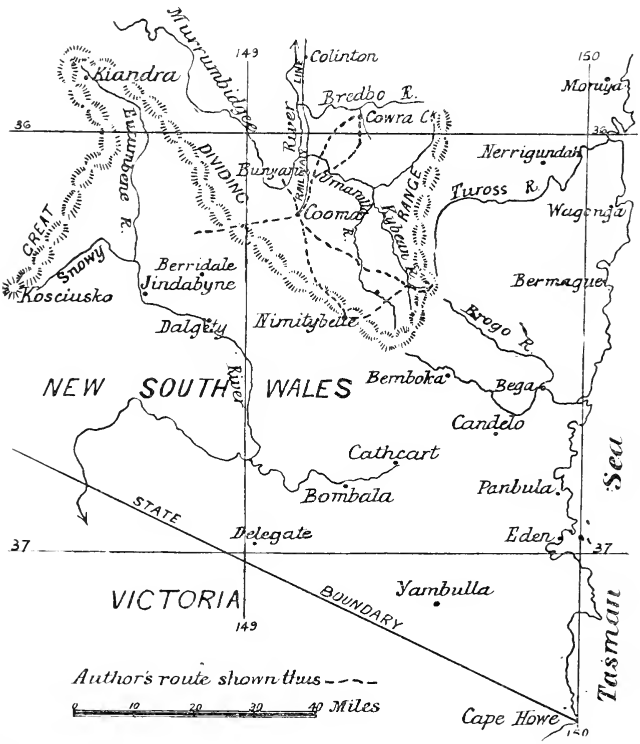
By R. H. Cambage, F.L.S.

Part vii. Eastern Monaro.

(Plate xxx.)

(Continued from These Proceedings, 1908, p.65.)

The area dealt with in this paper is that portion of the Monaro



Tableland lying chiefly to the east of Cooma and Nimitybelle, and falls within the Mountain-Area as a plant-zone in New

South Wales*. Its situation is just on the western side of the Great Dividing Range, which gives it, for the most part, a western rather than an eastern aspect, but being so near the divide, the locality is one in which the eastern and western floras mingle to some extent. The elevation above sea-level of the country around Cooma approximates 2,700 feet, while that in the vicinity of Nimitybelle and to the eastward, approaches 4,000 feet. The average annual rainfall at Cooma is scarcely 20 inches, but at Nimitybelle it amounts to nearly 26 inches.

It is remarkable that such an extensive tract of country as that known as the Monaro Plains, should naturally be almost destitute of trees and shrubs. From about 10 miles north of Cooma, southward almost to Nimitybelle, and then extending westerly to the Snowy River at Dalgety and towards Jindabyne, the country is made up of clear undulating plains, with only a few isolated tree-clad localities. Much of this area is covered with basalt of probably Tertiary age, furnishing a rich soil; but, although countless ages must have passed since the present conditions originated, some influence has continued to operate against the natural afforestation of this large extent of country. It seems probable that the absence of sheltering hills and gorges, and the insufficiency of the rainfall over an area swept by cold winds, have been factors in preventing the larger forms of plant-life from spreading more rapidly over these plains, for it must be remembered that in latitude $36\frac{1}{2}°$, and at an altitude of about 3,000 feet above sea-level, with a snow-clad mountain like Kosciusko within 50 miles, the conditions for several months in the year must be exceedingly bleak The presence of deep gorges leading up into the plateau would have had the effect of affording shelter for the growth of trees which might gradually acclimatise themselves to the higher levels, and so spread over the tableland. The formation of gorges would be assisted by an increased rainfall, especially if distributed as occasional torrential storms. Probably the moderately low rainfall on Monaro, in

* Cambage, R. H., "Climatic and Geological Influence on the Flora of N. S. Wales." Report Aust. Assoc. Adv. Science for 1907, p 473.

view of the geological formation, is one of the most important factors in limiting the growth of trees, for where basaltic areas in New South Wales produce a wealth of vegetation, the rainfall is high. Take Mount Wilson as an instance, with its noble forest and dense undergrowth of luxuriant graceful treeferns, and it is found to have an average annual rainfall of over 50 inches, or quite 2½ times that of Cooma. The difference is slightly greater at Kiama with its basaltic soil, and mean annual rainfall of over 54 inches; and the same applies to places on the North Coast. In spite of an annual rainfall of over 60 inches, the basaltic hills around Kiandra are very sparsely timbered, the extreme cold of a westerly aspect at an elevation approaching 5,000 feet, being too severe to admit of any robust growths. The aspect of Monaro Plains is rather more westerly than easterly, which is an important condition, for the warmer eastern aspect of both Mount Wilson and Kiama, together, of course, with the increased rainfall, has had a most important influence in producing vastly greater forest-growths.

The western atmosphere is dryer than the coastal; and, from local enquiries made, it would appear that the winds of Monaro come chiefly from the westward throughout the warmer months, thus replacing the bleakness of winter by the dry conditions of summer.

Further, the rocks of this area are for the most part igneous, of a basic character; even the granites have less acidity than what are known as acid granites; and it has been noticed in various parts of the State, that the acid (or siliceous) rocks are much more prolific in species than the basic, under similar conditions of moderate rainfall. On various parts of Monaro, where a few forest trees exist, the occurrence may fairly be attributed to the presence of rocks somewhat siliceous. Bushy Hill, which is composed of a crushed quartz-porphyry, is an instance, though this spot only supports a few Snow-gums (*Eucalyptus coriacea*); but the appearance of even these, in contrast with the nakedness of other elevations, has suggested the name of Bushy Hill for the auriferous prominence just to the east of Cooma.

It is worthy of note that in the surrounding districts, where the formation is sedimentary, granitic, or gneissoid, fair forest trees are found, though, owing to the exposed situation and only medium rainfall, the timbers are not of the finest. Even under present circumstances, had the site of Monaro Plains been composed of siliceous rocks instead of basic, it is not improbable that it would have been fairly well covered with forest trees.

Some of the reasons which account for this tableland being so thinly timbered may be briefly stated as follows:—the rainfall being only moderate, the rock-formation being basic rather than siliceous, absence of shelter, the great degree of cold, and the dryness of the prevailing summer winds which come from the west and north-west.

A study of the following rock-analyses in very instructive. Contrast the low percentage of silica in the basalt, with the high percentage in the gneiss. A granite containing less than 65 to 70% of silica is not remarkably acid, but when that amount is exceeded, the rock becomes decidedly siliceous. It is interesting to observe the gradation in the amount of silica from the basalt to the granites, quartz-porphyry and gneiss; and then to compare this with the increased forest-growths on the latter rocks over the first-named. If this result is actually due to the greater quantity of silica, it surely must be in some degree owing to the physical properties of the siliceous soil, rather than to the chemical constituents, for pure quartz cannot be regarded as a nourishing plant-food. Possibly the capillarity of the particles in the siliceous soil is greater than that of the basaltic, and the former is, therefore, better enabled to retain moisture and thereby sustain larger growths. The basaltic soil, in view of the limited rainfall, is suited only for the periodical production of smaller plants in response to damp seasons.

It may be noticed that, as the amount of silica increases in the rocks, various other constituents which go to furnish a good soil, gradually decrease.* The fact remains, however, that the basalt

*At the same time, the quantity of potash increases, and may have some considerable influence in producing the forest-growths.

areas around Cooma are undulating plains, valuable for grazing purposes in good seasons; while every siliceous prominence is denoted by forest-trees, though growing in an inferior soil.

I am indebted to Mr. E. F. Pittman, Under Secretary for Mines, for permission to publish the following rock-analyses, A and D, which will appear in the Mines Department Annual Report for 1909.

	A. *Olivine-Basalt.*		B. *Biotite-Granite.*
	%		%
Silica	45·06	..	66·58
Alumina	14·60	...	14·36
Ferric oxide	2·60	...	1·53
Ferrous oxide	9·00	...	3·19
Magnesia	9·64	..	1·70
Lime	9·86	...	4·18
Soda	2·90	...	3·09
Potash	0·85	...	3·37
Water(110°C)	0·55	...	0·17
Water(110°C+)	2·73	...	0·79
Carbon dioxide	0·05	...	0·04
Titanium dioxide	1·55	...	0·65
Zirconium oxide	abs.	...	abs.
Phosphoric anhydride	0·61	...	0·10
Sulphur trioxide	abs.	...	abs.
Chlorine	abs.	...	abs.
Sulphur(FeS_2)	abs.	...	abs.
Chromium sesquioxide	0·02	...	abs.
Nickel and cobalt protoxides	abs.	...	abs.
Manganous oxide	0·19	...	0·07
Baryta	tr.*	...	0·04
Strontia	tr.†	...	tr.†
Lithia	abs.	...	tr.†
Vanadium sesquioxide	0·02	...	tr.*
	100·23		99·86

A. Olivine Basalt obtained 2½ miles from Cooma on Jindabyne Road. Specific gravity, 2·911. (Analysis by Mr. H. P. White).

B. Biotite-Granite from Kybean Road, north of Bega Road. Specific gravity, 2·718. The absence of boric acid proved. (Analysis by Mr. H. P. White).

* Less than 0·01 %. † Spectroscopic reaction only.

	C. *Quartz-Porphyry.*		D. *Gneiss.*
	%		%
Silica	67·33	..	75·27
Alumina	14·03	...	11·77
Ferric oxide	1·86	...	1·95
Ferrous oxide	2·88	...	2·91
Magnesia	2·47	...	0·70
Lime	2·72	...	0·80
Soda	4·36	..	1·56
Potash	1·71	...	3·08
Water (110°C)	0·10	(100°C)	0·15
Water (110°C +)	1·76	(100°C +)	0·70
Carbon dioxide	0·03	...	0·03
Titanium dioxide	0·65	...	0·60
Zirconium oxide	abs.	...	tr.*
Phosphoric anhydride	0·22	...	0·19
Sulphur trioxide	abs.	...	abs.
Chlorine	abs.	...	tr.*
Fluorine	—	..	abs.
Sulphur (FeS_2)	abs.	...	abs.
Chromium sesquioxide	abs.	...	tr.*
Nickel and cobalt protoxides	tr.*	...	0·02
Manganous oxide	0·03	...	0·05
Baryta	0·04	...	0·05
Strontia	tr.†	..	present†
Lithia	abs.	...	present†
Vanadium sesquioxide	abs.	...	abs.
	100·19‡		99·83

C. Quartz-Porphyry from 2 miles N. of Cooma. Specific gravity, 2·731. (Analysis by Mr. H. P. White).

D. Gneiss from Cooma. Specific gravity, 2·7406. (Analysis by Mr. H. B. Gurney).

Kosciusko Plants.

For a list of plants occurring between the Snowy River, near Jindabyne, and the summit of Mount Kosciusko, see "A Contribution towards a Flora of Mount Kosciusko," in 1898, and a "Second Contribution," &c., in 1899, in the Agricultural Gazette of New South Wales, by J. H. Maiden.

* Less than 0 01 %. † Spectroscopic reaction only.

‡ For Analyses B and C, see Annual Report, Department of Mines, 1908, p. 134.

Plants absent from Monaro.

Owing chiefly to climatic reasons, several of the well known groups of New South Wales trees are absent from the area described in this paper. No species of either Ironbark or Box, not even a Yellow Box (*Eucalyptus melliodora*) was noticed, though it ascends as far as Collinton. *Sterculia diversifolia* G. Don, the well known Currajong, was not seen, and usually prefers warmer localities. No species of Angophora, the common Apple Tree around Sydney, appears to exist on the part of Monaro under discussion. The bleak conditions also restrict the ferns to a very few species. *Casuarina Cunninghamiana* Miq. (River Oak), though common on the central parts of the Murrumbidgee River, is apparently unable to withstand the rigidity of climatic conditions near Cooma; for, from the information available, it does not appear to ascend above the Michelago district. Though this tree is so common on the freshwater portion of our rivers, it has its limitations on the western watershed both against extreme cold and extreme heat, and flourishes best on the western slopes and lower mountain-areas.

Plants around Cooma.

Most of the plants collected within a few miles of Cooma were growing on gneiss-formation, which may be roughly described as a coarse schist with granitoid structure, suggestive of a crushed or stratified granite, and is a type of rock not very common in this State. The notes for this paper were taken chiefly in February, 1908, and supplemented during a short visit to Kybean early in November. (The name Kybean is pronounced with the accent on the first and last syllables.) The following is a list of plants noticed between Cooma and the Murrumbidgee River about five miles northerly :—

Clematis microphylla DC., *Hibbertia linearis* R.Br., var. *obtusifolia*, *Erysimum blenodioides* F.v.M., *Bursaria spinosa* Cav.(Thorn or Prickly Bush), *Stellaria pungens* Brongn., *Tunica prolifera* Scop.(*Dianthus proliferus* L., introduced), *Plagianthus pulchellus*

A. Gray (on the River), *Erodium cygnorum* Nees, *Stackhousia linarifolia* A. Cunn., *Discaria australis* Hk., *Dodonæa viscosa* L., var. *attenuata* (Hop Bush), *Mirbelia oxylobioides* F.v.M., *Daviesia corymbosa* Sm., *D. ulicina* Sm., *Bossiæa prostrata* R.Br , *B. riparia* A. Cunn.(?), *Glycine clandestina* Wendl., *Acacia rubida* A. Cunn., *A. decurrens* Willd. (common Green Wattle), *A. dealbata* Link, (Silver Wattle), *A. Dawsoni* R. T. Baker, *Tillæa verticillaris* DC., *Leptospermum flavescens* Sm., *L. lanigerum* Sm.(near the river), *Kunzea peduncularis* F.v.M., *Callistemon salignus* DC.,var. *Sieberi* (in the river), *Eucalyptus coriacea* A. Cunn. (Snow-Gum), *E. hæmastoma* Sm.(Brittle Gum or Brittle Jack), *E. viminalis* Labill., (White or Manna Gum with narrow "suckers"), *E. rubida* Deane and Maiden(a White Gum with orbicular "suckers"), *E. dives* Schauer (Peppermint), *E. Bridgesiana* R. T. Baker (called Apple in the absence of an Angophora : one of the trees recognised by Baron von Mueller as *E. Stuartiana* F.v.M), *Asperula oligantha* F.v.M., *Galium umbrosum* Sol., *Vittadinia australis* A. Rich., *Brachycome ciliaris* Less., *B. calocarpa* F.v.M., *Craspedia Richea* Cass., *Cassinia longifolia* R.Br., *Helichrysum apiculatum* DC., *H. lucidum* Henk.(Everlasting Flower), *Helipterum incanum* DC , *Wahlenbergia gracilis* DC.(Blue Bell), *Astroloma humifusum* R.Br.(Ground Berries), *Melichrus urceolatus* R.Br., *Brachyloma daphnoides* Benth., *Veronica Derwentia* Andr., *Ajuga australis* R.Br., *Plantago varia* R.Br., *Rumex acetosella* L.(Sorrel : introduced), *Grevillea lanigera* A. Cunn., *Hakea microcarpa* R.Br (a small Needle Bush), *Lomatia longifolia* R.Br., *Pimelea pauciflora* R Br.(on bank of river), *P. glauca* R.Br., *Urtica incisa* Poir. (Nettle), *Omphacomeria acerba* DC.(Sour Jacks), *Exocarpus stricta* R.Br., *Callitris calcarata* R.Br.(known variously as Black, Green or Mountain Pine), *Xerotes longifolia* R.Br., *Arundo Phragmites* Dod (in the river), *Cheilanthes tenuifolia* Swartz, and *Asplenium flabellifolium* Cav.(two small ferns found among the rocks).

Cooma to Cootralantra.

Owing to the sparseness of the flora between Cooma and Cootralantra, a distance westerly of about 18 miles, only the following plants were noticed by the roadside:—*Bursaria spinosa*, *Oxalis corniculata* Linn., *Acacia dealbata*, *A. melanoxylon* R.Br., *Eucalyptus viminalis*, *E. coriacea*, *E. rubida*(in one case a host for a species of Loranthus), *E. stellulata* Sieb.(Black Sally), *Wahlenbergia gracilis*, *Helichrysum apiculatum*, *Brachycome* sp., *Cassinia longifolia*, *Hypericum gramineum* Forst., *Callitris calcarata*, *Hordeum murinum* Linn.(Barley Grass; introduced), and *Pappophorum commune* F.v.M.

Cooma to Nimitybelle.

Nimitybelle is situated about 23 miles southerly from Cooma. The first 16 miles are confined to undulating basaltic plains, with here and there a few trees of *Eucalyptus coriacea*, or *Acacia melanoxylon*. The celebrated natural soda-water spring, an aërated ferruginous water of commercial value, occurs by the side of this road, near the 10-mile post. After passing the 16-mile post, thinly timbered areas are met with, chiefly of *Eucalyptus coriacea*, *E. rubida* and *Acacia dealbata*. This sparse forest is possibly the advance guard gradually taking possession of the plain, and is supported by more abundant growths on the granites to the south-east, where there is also a greater rainfall.

It is remarkable how *Acacia melanoxylon*, the Tasmanian Blackwood, sometimes called Hickory in this State, and Mudgerabah on the eastern falls of New England, often selects the stony basaltic summits on Monaro. In such situations its habit is dwarfed and somewhat gnarled, owing to its exposure to severe climatic conditions; and its general appearance would scarcely even suggest to the casual observer that it has any close affinity with the same species as seen in Southern Victoria and Tasmania, where the boles often attain a diameter of 2-3 feet. A favourite locality for the species is a gully in basaltic formation.

With the exception of grasses, the only plants noticed between Cooma and Nimitybelle were:—*Erodium cygnorum* Nees, *E. cicutarium* Willd.(introduced), *Discaria australis* Hk., *Acacia melanoxylon* R.Br., *A. dealbata*, *Eucalyptus coriacea*, *E. rubida*, *Cassinia longifolia*, *Wahlenbergia gracilis*, *Pimelea glauca*, and *Hordeum murinum* L.(Barley Grass).

The botanical name of *Eucalyptus rubida*, often a White Gum, was suggested by the presence of patches of plum-coloured bark which are often to be seen just before the outer layers are shed. The colouring is evidently caused by exposure to the sun, and in February the feature was most interesting in the open forest near Nimitybelle, for on approaching the trees from the south they were seen to be white, while the trunks presented a red surface to the north or sunny side. The distinctive colouring was so pronounced that an observant bushman would be able to utilize it as a compass, and on a snowy or dull day the assistance which could be obtained from noting the feature would be invaluable in determining the cardinal points, and thus directing the traveller on a straight course. The red colour indicated the north as accurately as the moss (Lichens) on an old fence or tree-trunk defines the south.

Nimitybelle to Kybean River and Kydra Mountain.

Between Nimitybelle and Mowitt's Swamp near the Kybean River, thence to Kydra Mountain, the following plants were noticed :—

RANUNCULACEÆ : *Ranunculus lappaceus* Sm. (Buttercup), *R. rivularis* Banks & Sol., *R. hirtus* Banks & Sol.

DILLENIACEÆ : *Hibbertia linearis* R.Br., var. *obtusifolia*, *H. pedunculata* R.Br.

MAGNOLIACEÆ : *Drimys aromatica* F v.M.

CRUCIFERÆ: *Cardamine tenuifolia* Hk., *Capsella bursa-pastoris* L.(Shepherd's Purse).

VIOLARIEÆ : *Viola betonicæfolia* Sm., *V. hederacea* Labill., *Hymenanthera dentata* R.Br., var. *angustifolia* Benth.,(*H. angustifolia* R.Br.).

PITTOSPOREÆ : *Bursaria spinosa* Cav., *Marianthus procumbens* Benth., *Billardiera scandens* Sm.(Rolypoly vine).

POLYGALEÆ : *Comesperma defoliatum* F.v.M.

CARYOPHYLLEÆ : *Stellaria pungens* Brongn.

PORTULACEÆ: *Claytonia australasica* Hk.(white flowers, thickly sprinkled in places along the river-bank).

GERANIACEÆ: *Geranium sessiliflorum* Cav., *Erodium cicutarium* Willd.(Crane's-bill; introduced).

RUTACEÆ: *Boronia algida* F.v.M.(pink flowers), *B. polygalifolia* Sm.,var. *pubescens* Benth.(flowers almost white; both growing on the conglomerate), *Phebalium diosmeum* A. Juss.(3 feet high, with yellow flowers, on river-bank), *Phebalium* sp.

STACKHOUSIEÆ: *Stackhousia linarifolia* A. Cunn.

RHAMNEÆ: *Pomaderris* sp., *Cryptandra amara* Sm.

LEGUMINOSÆ: *Oxylobium alpestre* F.v.M., *Mirbelia oxylobioides* F.v.M., *Gompholobium minus* Sm., *Daviesia corymbosa* Sm., *D. ulicina* Sm., *Pultenæa* sp.(No.1989), *Dillwynia ericifolia* Sm., (quite prostrate), *D. floribunda* Sm.(near Kydra Trig. Station), *Bossiaea foliosa* A. Cunn.(common on the granite, with yellow flowers and very small leaves), *Swainsona phacoides* Benth., var. *parviflora*, *Hardenbergia monophylla* Benth.(so-called Sarsaparilla; a twining plant with beautiful purple flowers), *Acacia siculiformis* A. Cunn., *A. juniperina* Willd., *A. dealbata* Link,(Silver Wattle), *A. melanoxylon* R.Br., *A. falcata* Willd., *A. penninervis* Sieb.(fairly large trees), *A. obtusata* Sieb.(?), *A. lunata* Sieb., var.(on head of Tuross River, near Kydra Trig. Station; No. 2000).

ROSACEÆ: *Rubus parvifolius* L.

CRASSULACEÆ: *Tillæa verticillaris* DC.

MYRTACEÆ: *Bæckea Gunniana* Schauer, *B. Cunninghamii* Benth.(?), *B.* sp No.1990 (possibly a new species), *Leptospermum myrsinoides* Schl., *L. lanigerum* Sm., *L. flavescens* Sm.(all three often known as Tea-tree), *Kunzea* sp., *Callistemon pithyoides* Miq., *Eucalyptus stellulata* Sieb.(Black Sally), *E. coriacea* A. Cunn. (Snow Gum or White Sally), *E. amygdalina* Labill.(Peppermint or Messmate, fairly large trees), *E. viminalis* Labill.(Manna or White Gum), *E. rubida* Deane and Maiden(*E. Gunnii* var. *rubida* Maiden, a White Gum), *E. dives* Schauer(Peppermint), *E. maculosa* R. T. Baker(*E. Gunnii* var. *maculosa* Maiden; Spotted Gum, but not the well known coastal tree), *E. regnans* var. *fastigata* Maiden(*E. fastigata* Deane and Maiden; Cut-tail or Messmate), *E. Sieberiana* F.v.M.(Mountain Ash, the well known coastal tree), *E. fraxinoides* Deane and Maiden(*E. virgata* var. *fraxinoides* Maiden, a large gum tree or White Ash; east of Main Divide and south of Kydra Trig. Station), *E. Moorei* Maiden and Cambage(growing like a Mallee at head of Tuross River, near Kydra Trig. Station), *E. parvifolia*, sp.nov., *E. amygdalina* Labill., var. *nitida* Benth. (?) (No. 2004), *E.* sp.(No. 1980).

UMBELLIFERÆ : *Siebera Billardieri* Benth.

ARALIACEÆ : *Panax sambucifolius* Sieb.

RUBIACEÆ : *Coprosma hirtella* Labill., *Asperula oligantha* F.v.M.

COMPOSITÆ: *Olearia myrsinoides* Labill., *O. stellulata* Labill.(?), *Brachycome* sp., *Craspedia Richea* Cass.(Yellow Buttons), *Helichrysum scorpioides* Labill., *H. semipapposum* DC., *H. apiculatum* DC., *Helipterum anthemoides* DC., *H. incanum* DC.

STYLIDEÆ : *Stylidium graminifolium* Sw.(Trigger-Flower).

GOODENIACEÆ: *Goodenia hederacea* Sm., *Dampiera stricta* R.Br.

CAMPANULACEÆ : *Wahlenbergia gracilis* DC.(Blue Bell).

ERICACEÆ : *Gaultheria hispida* R.Br.(Snow-Berries).

EPACRIDEÆ : *Styphelia* sp.(no flowers), *Brachyloma daphnoides* Benth., *Leucopogon lanceolatus* R.Br., *L. Hookeri* Sond., *Acrotriche divaricata* R.Br., *Epacris petrophila* Hk., *E. robusta* Benth., *E. paludosa* R.Br., *E. microphylla* R.Br.

GENTIANEÆ : *Gentiana montana* Forst., (Gentian, locally called Bridal Flowers).

CONVOLVULACEÆ : *Convolvulus marginatus* Poir.

SCROPHULARINEÆ : *Veronica Derwentia* Andr., *V.* sp.(about 2 inches high, with blue flower), *Euphrasia Brownii* F.v.M.

LENTIBULARINEÆ : *Utricularia dichotoma* Labill., var. *uniflora.*

LABIATÆ : *Prunella vulgaris* DC., *Ajuga australis* R.Br.

PLANTAGINEÆ : *Plantago varia* R.Br.

PARONYCHIACEÆ : *Scleranthus biflorus* Hk.(forming pale green dense tufts or mats, usually 6-9 inches across, and 1-2 inches high).

LAURINEÆ : *Cassytha phæolasia* F.v.M.(Dodder).

PROTEACEÆ : *Isopogon ceratophyllus* R.Br.(quite prostrate, on conglomerate-formation near Kydra Trig. Station), *Persoonia* *lanceolata* Andr.(?)(Geebung), *P. oxycoccoides* Sieb., *Grevillea lanigera* A. Cunn (red flowers), *Hakea microcarpa* R.Br.(Needle-bush) *H. dactyloides* Cav., *Lomatia longifolia* R.Br, *Banksia marginata* Cav.(Honeysuckle), *B. integrifolia* L.

CASUARINEÆ: *Casuarina stricta* Ait.,(*C. quadrivalvis* Labill.; Sheoak), *C. nana* Sieb.

SANTALACEÆ: *Choretrum spicatum* F.v.M., *C. Candollei* F.v.M., *Exocarpus cupressiformis* Labill.(Native Cherry), *E. stricta* R.Br. (very common on Kydra Mountain).

ORCHIDEÆ: *Caladenia testacea* R.Br.

IRIDEÆ: *Patersonia sericea* R.Br.(Wild Iris).

AMARYLLIDEÆ: *Hypoxis hygrometrica* Labill.

LILIACEÆ: *Dianella revoluta* R.Br., *Xerotes glauca* R.Br.

JUNCACEÆ: *Luzula campestris* DC.(Pepper and Salt).

GRAMINEÆ: *Themeda Forskalii* Hook.(*Anthistiria ciliata* L.; Kangaroo Grass).

FILICES: *Gleichenia dicarpa* R.Br.(Braid or Bead Fern) *Adiantum aethiopicum* L.(Maidenhair Fern), *Pteris aquilina* L, (Bracken), *Blechnum discolor* (Forst.) Kunze,(*Lomaria discolor* Willd.), *Asplenium flabellifolium* Cav.

MUSCI: *Leptostomum erectum* R.Br.,(Moss, on shady side of granite rock).

About one mile easterly from Nimitybelle, along the Bega Road, the country changes from basalt to granite; and this is followed by an increased number of both plants and species. The formation on Kydra Mountain is sedimentary, probably Silurian. The elevation over a great portion of this area approximates 3000-4000 feet; which, in this southern latitude, furnishes climatic conditions suitable for the growth of many Tasmanian plants.

Nimitybelle is situated just on the coastal or Snowy River watershed, the Main Divide passing along the northern edge of the village. The route followed to Kybean crosses the Great Dividing Range in about a mile, and continues on the north-western or Murrumbidgee watershed. The Main Divide has an easterly course from Nimitybelle, but curves round to the north after passing the head of the Umaralla River. This northerly extension was intersected near the head of Mowitt's Swamp Creek opposite the Brogo and Tuross Rivers, where the formation is sedimentary, that forming the actual summit of the Main Range being a sandy conglomerate, suggestive of the Devonian period, though no fossils were found. The flora of these highly siliceous conglomerate hills differs considerably from that of the granite, the former producing many Sydney and Blue Mountain plants, though often in a dwarfed form owing to the rigid climatic conditions and poorness of soil. The range in this locality has a wonderful effect upon the vegetation. It rises from the west with a fairly pronounced slope, while its eastern face is steep, and scored into deep gullies, as a result of the denudation which is necessarily consequent upon the rapid course of the coastal streams, which, starting at an elevation of about 4000 feet, are less than 35 miles from the ocean in a direct line. Having one steep face exposed to the ocean, with the attendant conditions of warmth, shelter, and moisture, as well as being shut off from the drying westerly influence, while the other face has the conditions reversed, this high range exerts a most interesting and decided effect upon the plant-life in this locality. Generally throughout its course the Main Range in New South Wales occupies a position approximating the centre of the mountain-area, but in the vicinity under discussion it forms the eastern margin of the plateau. On ascending from the western side, amongst trees which favour a western aspect, it is noticed as the summit is approached that many of the Eucalypts become dwarfed, though partly owing to the change of geological formation, and after being reduced to some 5-10 feet high, cease altogether, the actual crest, for a width of a few hundred yards, being nothing more than a heath, with *Casuarina nana* as one of the principal constituents. The evidence of failure, on the part of many western-loving plants, to overcome the warmer coastal influence is most pronounced. Perhaps one of the best examples of failure is to be found in the Snow Gum, *Eucalyptus coriacea.* Although this tree braves the cold and snowy elements better, and ascends higher on our exposed mountains than any other Eucalypt, it may be said to fairly succumb at Kybean, the moment the full strength of the coastal conditions is encountered.

When nearing the summit from the west, it was a curious sight to see the tops of large gum trees of a different species gradually coming into view from the coastal side. These were found to be *Eucalyptus fraxinoides* Deane and Maiden, nestling around the heads of the gullies having an eastern aspect, and not one tree of this species was noticed on the exposed western face. Tree-ferns and brush-growths are said to flourish in the eastern gorges before they have descended a mile. The time at my disposal for investigation was very limited, but it seems clear that the locality presents excellent material for studying the effects of aspect, temperature, shelter, and moisture upon the growth of plants.*

Hymenanthera dentata var. *angustifolia*, laden with green berries which are bluish when ripe, was found growing in a curious, spreading, prickly-looking mass, often covering rocks, and in habit totally unlike *H. dentata* when seen near the Nepean, Cox's River, or Kangaroo Valley as an erect shrub of several feet.

A remarkable prostrate form of *Dillwynia ericifolia* was noticed on the granite-formation close to the bank of the Kybean River, at about 3500 feet above sea-level, much of the plant being covered with yellow flowers, while the stems are partially imbedded in the soil. An exactly similar form has been noticed in two localities near Braidwood, also on granite, at an elevation of slightly over 2000 feet, so that the prostration cannot be attributed solely to severe climatic conditions. At Sydney and on the Blue Mountains, *D. ericifolia* is a very common, yellow-flowered, little shrub of a few feet, erect in habit, though often diffuse.

The plant referred to as *Acacia lunata* var. (No. 2000) was found near the head of the Tuross River on the conglomerate

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* For reference by the Rev. W. B. Clarke, M.A., to the remarkable change of climate in this locality, see Clarke's "Southern Gold-Fields," pp. 149-150.

area, and is a dense spreading shrub of about 6-8 feet, flowering in October. It appears to be distinct from that collected near Cowra Creek(No.1878), which is regarded as a possible variety of *A. linifolia*, and both have some characters different from the typical Sydney plant (*A. linifolia*), which, however, is known to exhibit considerable variation.

An interesting Bæckea(No.1990) was found plentifully distributed over the sandy conglomerate-hills, at elevations up to 4000 feet. The plant is quite prostrate, spreading from 1-2 feet across, and early in November is charmingly crested with a profusive display of white flowers, in some cases very faintly tinged with pink. The ovate leaves are about 3-4 lines long, and slightly ciliate on the edges. This is possibly a new species.*

Leptospermum myrsinoides (a Tea-tree shrub) was fairly common in the valleys between Nimitybelle and Kybean; and, although the flowers were white, it has been noticed that in a few weeks they turned quite yellow in the specimens collected.

Gaultheria hispida, a shrub of about 3-4 feet, was found on the banks of Mowitt's Swamp Creek, near its source. This is a common Tasmanian plant, and usually attracts the attention of visitors to Mount Wellington, owing to its pendulous clusters of pure white berry-like fruits, which are exceedingly ornamental and known in some parts of Tasmania as snow-berries. This species occurs on the higher parts of this State at such places as Jenolan Caves, Mount Wilson, and New England.

Epacris robusta, a somewhat rare plant, is plentiful on the sandy conglomerate of the Main Range, at 4000 feet, near Kydra Trig. Station. It resembles *E. obtusifolia* Sm., but is even more beautiful when laden with masses of white flowers early in November.

Grevillea lanigera occurs intermittently throughout the area described, and was the only Grevillea noticed. The genus is but sparsely represented in the coldest parts of the State, and in Tasmania.

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* To be described by Messrs. Maiden and Betche as *B. denticulata*, in These Proceedings *(postea)*.

Banksia marginata (Honeysuckle) is fairly common on the granite-formation between Nimitybelle and Kybean. *B. integrifolia* was not seen on the granite, but is common on the conglomerate from 3600 to 4000 feet, though, owing to severity of climate, it is remarkably dwarfed; and instead of trees 40 feet high, as seen along the coast, the average height of plants bearing mature cones is from 2-5 feet.

Casuarina stricta (*C. quadrivalvis* Labill.) may be seen beside the road-cutting which passes down the Kydra Mountain to the Umaralla River. This somewhat drooping, large-coned Sheoak, which occurs on many of the hill-tops in the western districts, at least as far out as Cobar, is not a lover of the cold portions of the State, although growing in parts of Tasmania. It has probably reached the locality under discussion by working its way up along some of the sheltered ridges within the valley of the Murrumbidgee, its occurrence some 20 miles south-west of Yass having been recently noticed. It never grows on a river-flat. On Kydra Mountain it is found at an elevation of about 3000 feet above sea-level, an unusual altitude, but it is interesting to observe the great discrimination it exercises in its selection of a suitable aspect. On Monaro the extreme cold is on the southern aspect, and although *Casuarina stricta* was found growing freely on the northern side of a steep hill, not a single tree of this species was seen where the road winds round the southern face; but on the opposite side of the gorge, where another hill faces north, the oak trees were again plentiful. Generally this species avoids the shelter of larger trees, and selects fairly open hills, but here it was distributed through the forest of Eucalypts after the manner of *Casuarina suberosa* and *C. torulosa*, and was growing on highly inclined Silurian slate-formation.

In these Proceedings for 1905(p.376) I referred to the probable antiquity of *C. stricta*, when accounting for its wide and varied distribution; and the example now mentioned, showing its remarkable potentialities for acclimatising itself in a cold region, though usually favouring a warm one, is at least suggestive of a long period being required for it to establish itself at this altitude, and serves to illustrate the wonderful, though perhaps gradual, adaptability of plants to environment.

C. nana was common on part of Kydra Mountain, and on the Main Divide, occupying the latter almost exclusively for some considerable distance.

Eucalyptus maculosa (sometimes called Spotted Gum) was noticed between the Umaralla River and Dangelong. This species does not appear able to withstand the extreme cold of high altitudes so well as *E coriacea* or *E. rubida*, and occupies chiefly the central and western side of the mountain-area from the Upper Hunter southerly, extending into Victoria at least as far as Ballarat. It is often associated with *E. dives*(Peppermint).

Eucalyptus Moorei was found growing in Mallee-like form in the open gullies just on the eastern side of the Main Range, on the actual head-waters of the Tuross River, and seemed confined to the siliceous conglomerate-formation. Except that the foliage, chiefly the juvenile growth, is somewhat broader than that of the type, it otherwise corresponds exactly with the Blue Mountain shrub; and in both cases is growing near the summit of the mountain-zone on highly siliceous geological formations, very slightly favouring an eastern or coastal aspect, but with more rigid climatic conditions at Kybean than at Blackheath. In no case does it appear to attain the dignity of a tree, reaching, at Kybean, a height of 10-12 feet, with a diameter of 2-5 inches. Typical *E. stellulata*, which it resembles in herbarium material when juvenile foliage is absent, was growing some 3 or 4 miles off, up to 50 feet high, with a diameter of $2\frac{1}{2}$ feet, and having very broadly ovate, or in some cases almost orbicular "suckers."

Another Mallee-like Eucalypt,* 6-10 feet high, was noticed in patches on the bald conglomerate-hills, and appears to be similar to a form found in very limited quantity at Blackheath by Mr. Maiden and myself, and referred to as Form C, in these Proceedings for 1905 (p.201). This plant, which was in full flower at the end of October, will be further investigated by us.

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* (No. 1980).

E. amygdalina var. *nitida* (?)(No.2004) was found growing in Mallee-like form, 6-8 feet high, about 50 yards southerly from Kydra Trig. Station, and associated with No. 1980, on the sandy conglomerate-formation, at 4030 feet above sea-level. It has very smooth shining leaves and was beginning to flower early in November, and seemed quite distinct from typical *E. amygdalina*, which was growing as large forest-trees, a few hundred yards away.

E. Sieberiana(Mountain Ash) so well known on the sandstone areas of the eastern slope, was not plentiful at Kybean, and generally prefers the eastern rather than the western side of our mountains. It was seen on a granite-hill across the river, opposite Mr. Tivey's residence.

An interesting species of Eucalyptus, with remarkably small leaves, was found on the flats bordering the head-waters of the Kybean River, and, from its association with *E. stellulata*(Black Sally) and a passing resemblance to that species, was locally known as Small-leaved Sally. This proves to be a new species(see p. 336).

Cooma to Cowra Creek and Macanally.

From Cooma to Cowra Creek is a distance north-easterly of about 20 miles, the first half of the road passing over open plains, while the second half is confined to rough hills of tilted Silurian slates, fairly well covered with Eucalypts of medium height, and an undergrowth of shrubs and dried-looking tussocky grass(*Danthonia penicillata*), the latter, when associated with *Eucalyptus hæmastoma*(Brittle Gum) among the brown protruding edges of the rocks, imparting a somewhat dreary aspect to the forest scene. Macanally is a locality in the same slate-area, about 5 miles southerly from Cowra Creek, at both of which places gold mining is carried on. In returning to Cooma the road passing Rosebrook from Macanally was followed. With the exception of *Discaria australis*, the whole of the plants mentioned in the following list were noticed on the slate-area referred to.

Around Cowra Creek and Macanally.

DILLENIACEÆ: *Hibbertia linearis* R.Br., var. *obtusifolia*.

PITTOSPOREÆ: *Bursaria spinosa* Cav.

GERANIACEÆ: *Oxalis corniculata* L.

RHAMNEÆ: *Discaria australis* Hk.

SAPINDACEÆ: *Dodonaea viscosa* L.(Hopbush).

LEGUMINOSÆ: *Oxylobium ellipticum* R.Br., var. *alpinum*(Wild. Wallflower), *Daviesia corymbosa* Sm., (narrow-leaved form), *D. ulicina* Sm., *Pultenæa procumbens* A. Cunn., *P. microphylla* Sieb., *Indigofera australis* Willd.(Lilac), *Hardenbergia monophylla* Benth.(False Sarsaparilla), *Acacia siculiformis* A. Cunn., *A. diffusa* Lindl.(Prickly Wattle), *A. undulifolia* Fraser (very common between Macanally and Rosebrook, near foot of mountain), *A. verniciflua* A. Cunn., *A. penninervis* Sieb., (Hickory, 40 feet high), *A. rubida* A. Cunn., *A. lunata* Sieb., *A. dealbata* Link(Silver Wattle), *A. linifolia* Willd., var.(No.1878), *A. Dawsoni* R. T. Baker.

MYRTACEÆ: *Leptospermum flavescens* Sm., *L myrsinoides* Schl., *Callistemon pithyoides* Miq., *Eucalyptus stellulata* Sieb., *E. coriacea* A. Cunn., *E. macrorrhyncha* F.v.M.(Stringybark), *E. hæmastoma* Sm.(Brittle Gum or Brittle Jack), *E. pulvigera* A. Cunn., *E. viminalis* Labill.(Manna or White Gum), *E. Bridgesiana* R. T. Baker(Apple), *E, rubida* Deane & Maiden(White Gum), *E. maculosa* R. T. Baker, *E. dives* Schauer(Peppermint).

LORANTHACEÆ: *Loranthus* sp.

COMPOSITÆ: *Brachycome* sp., *Cassinia longifolia* R.Br., *C. aculeata* R.Br., var. *uncata*, *Helichrysum apiculatum* DC.

CAMPANULACEÆ: *Wahlenbergia gracilis* DC.(Blue Bell).

EPACRIDEÆ: *Melichrus urceolatus* R.Br., *Leucopogon attenuatus* A. Cunn., *L. Hookeri* Sond.

SCROPHULARINEÆ: *Veronica Derwentia* Andr.

PROTEACEÆ: *Persoonia rigida* R.Br., *P. chamæpeuce* Lhotsky, *Grevillea lanigera* A. Cunn., *Hakea microcarpa* R.Br.

SANTALACEÆ: *Choretrum spicatum* F.v.M., *Omphacomeria acerba* DC.(Sour Jacks), *Exocarpus cupressiformis* Labill.(Native Cherry), *E. stricta* R.Br.

CONIFERÆ: *Callitris calcarata* R.Br.(Black or Mountain Pine).
LILIACEÆ: *Dianella revoluta* R.Br.(?)(Wild Flax).
GRAMINEÆ: *Danthonia penicillata* F.v.M., var. *pallida*.
FILICES: *Pteris aquilina* L.(Bracken).

A very narrow-leaved form of *Daviesia corymbosa* was noticed, and found to be constant throughout the district as well as on Kydra Mountain; and, when compared with the typical broad-leaved form as seen near Nimitybelle and elsewhere, was certainly suggestive of being a separate and smaller species. This form occurs in other parts of this State.

Pultenæa microphylla was found as an absolutely prostrate plant, quite dissimilar in habit from the erect little shrubs collected at Gilgandra and Scone, and which have been referred to by Messrs. Maiden and Betche in these Proceedings for 1908 (p.310) as connecting links between *P. cinerascens* Maiden and Betche, and *P. microphylla*.

Acacia rubida was distributed throughout the area, and here, as elsewhere, was noticed to retain its juvenile leaflets mingled with the phyllodia, until the plant was nearly full-grown. It is not uncommon to find this feature in very young plants of many Acacias, but few retain the two forms of foliage so long as *A. rubida*. A young plant of *A. melanoxylon*, when growing luxuriantly in sheltered situations, will sometimes speedily reach several feet before showing any phyllodia, after which it presents a remarkable appearance with its dimorphic foliage, until finally reaching the stage when none of the leaflets remain.

Considerable interest attaches to the discovery of *Acacia Dawsoni* in the Cooma district, viz., at about 5 miles northerly from Cooma and a few hundred yards south of the bridge over the Murrumbidgee River, on gneiss-formation; also on the roads from Cooma to Cowra Creek and to Macanally on Silurian slate. In each case the shrubs are about 4 feet high, and somewhat spreading. Prior to 1907, this species was recorded only from Rylstone (type-locality) and Abercrombie, but in that year it was found by me at Emmaville, and in 1908 at Cooma, thus extending its range almost through the entire length of the State, but in all cases so situated as to be subject to the westerly influence.

The genus Loranthus (Mistletoes) does not appear to be strongly represented over the area described, but when going from Cowra Creek to Macanally, several Loranths were found at one spot only, where a belt of diorite about 20 yards wide crossed the track, the hosts being *Eucalyptus macrorrhyncha* and *E. maculosa*. Though they were certainly more plentiful on the diorite, the occurrence was not strictly confined to that formation, and though somewhat remarkable may be only a coincidence.

One of the most interesting species met with on Eastern Monaro was *Eucalyptus pulvigera* A. Cunn., owing chiefly to its rarity, and partly because of its probable identity with *E. pulverulenta* Sims. This plant was referred to by me in these Proceedings for 1902 (p.585), when its strong affinities with *E. cordata* Labill., of Tasmania, and its resemblance to *E. pulverulenta* were discussed.

E. pulvigera was described by Allan Cunningham from specimens collected at Cox's River, near Bowenfels, on 8th October, 1822. It is a shrubby species, seldom reaching 20 feet high, and often less than 12, with a smooth, greenish-white, gum-tree bark, which is eventually cast off in long brown ribbons. Its tough stems are commonly from 2-3 inches in diameter, but are usually bent over, and, in some instances, are quite prostrate. Its most remarkable characteristic, however, is in the colour, shape, and disposition of the leaves. These are either orbicular or broadly ovate, and grow along the branches in decussate pairs, about an inch apart, being covered on both sides with a fine glaucous powder which gives to the little trees a bluish-white tint. There is an absence of the lanceolate leaves so common amongst the mature foliage of the genus, and altogether the general appearance of these dwarf Eucalypts with their rambling habit is decidedly quaint and striking. The branches are placed approximately at right angles to the stem, and the leaves at right angles to the branches, so that, when viewed from certain positions, only the edges of the leaves can be seen, resembling circular blades. The foliage, which is exceedingly rich in eucalyptol, loses the white powder with maturity, and when, by contact with adjoining trees, it is rubbed off the young leaves, these present a bright rich green appearance, especially if in shadow. Another curious feature is that the leaves through being sessile, cordate and opposite, imprint circular marks on the branches and stems, which remain for several years after the leaves have fallen, but disappear when the bark is shed at the end of about four years. That the species is rare, is shown by the fact that, after Cunningham found it in 1822, it was not again collected till a very small patch of it was noticed by me in 1900, at Cow Flat, near Bathurst, on micaceous schist-formation. A third locality, on Silurian slate-formation, viz., Cowra Creek, near Cooma, is now added, after a further lapse of eight years, or 86 years since Cunningham's discovery.

In October, 1904, I visited Cox's River, in company with Mr. J. H. Maiden, for the purpose of ascertaining whether any plants of *E. pulvigera* remained, and we found a considerable quantity extending from the top of Mount Blaxland (where Cunningham probably collected it, 82 years before) across to the northern side of Cox's River, and on the roadside leading from Bowenfels to the river, growing on aplitic granite-formation.

After referring to the differences and close affinities between *E. pulvigera* and *E. cordata*, in these Proceedings for 1902, I was disposed to regard one as a variety of the other, thinking that possibly a connecting link would be found in some locality between Bathurst and Tasmania, where a plant showing gradations to both might be discovered. The surmise is partly borne out by the discovery of *E. pulvigera* near Cooma, some 200 miles south of Bathurst, but after examination, the specimens are found to be practically identical with the Bathurst and Cox's River forms, so that there seems no reason why *E. pulvigera* should not have specific rank. At the same time it is highly probable that both had a common origin, and have developed differences owing to environment, extending over long ages. Both are rare, diminutive in size, and, it seems likely, are slowly vanishing species. Around Cowra Creek the plants occur in small clumps of an acre or so, and are considered rare even in that locality. The same applies both to Cox's River and Bathurst.

E. pulvigera is discussed by Mr. J. H. Maiden, F.L.S., in these Proceedings for 1904 (p.769).

In the Report of the Australasian Association for the Advancement of Science for 1901(Vol.ix., p.345), Mr. R. T. Baker, F.L.S., refers to *E. cordata* and *E. pulvigera* as distinct species, but regards the latter as identical with *E. pulverulenta* Sims(Bot. Mag. t. 2087) which was described in 1819, or three years before Cunningham's discovery of the plant. Up to 1901, Australian botanists had recognised a tree known as the Argyle Apple, which grows in the Goulburn district (County of Argyle), as *E. pulverulenta*, and which is undoubtedly distinct from *E. pulvigera*. Baron von Mueller described what he afterwards rightly regarded as only a form of the Argyle Apple, naming it *E.cinerea*. This name Mr. Baker resuscitated for the species, when deciding to adopt the name of *E pulverulenta* for the Cox's River plant. My greatest difficulty in accepting the Cox's River tree as *E. pulverulenta* was that only six years had elapsed from the time the explorers first reached that locality in 1813, till the species was flowering, and the description published from a cultivated plant in England in 1819. Knowing also that no similar geological formation to that at Cox's River occurred near the road between that point and Sydney, it seemed doubtful if the plant ever grew at a place that was earlier accessible. The possibility of the described species having been raised from seeds collected at Cox's River has, however, since been demonstrated; for seeds brought thence in October, 1904, have produced plants which flowered in three years and five months (Plate xxx.). It must be remembered, however, that in the early days, after seeds were collected here, quite six months would probably elapse, before they could be planted in England. The terminal point reached by Blaxland and party in 1813, was a few hundred yards south of Mount Blaxland. Between 1813 and 1815, a road was constructed to

Bathurst, and collections of seeds may have been made during that period; but in Major Antill's diary, describing Governor Macquarie's visit to Bathurst, under date 30th April, 1815, it is stated that a party walked up Cox's River from the crossing to the waterfall, and collected seeds on the way up.

Seedlings of *E. pulvigera* and the Argyle Apple which were growing in pots side by side, were very similar in appearance for the first year, the difference being in the colour of the stems, those of the former being greenish, while those of the latter were brown, both being indicative of the future colour of the bark. In mature growth the trees are quite dissimilar. The original description and plate of *E. pulverulenta* correspond better with *E pulvigera* than with the Argyle Apple (*E. cinerea* F.v.M.), and it seems likely that the little Cox's River tree would have been identified as *E. pulverulenta*, whether rightly or wrongly, if it had not been so rare as to escape the notice of botanists for about 80 years. The evidence now available favours the suggestion that *E. pulvigera* A. Cunn., is synonymous with *E. pulverulenta* Sims.

List of Acacias.

A complete list of Acacias noticed on Eastern Monaro is as follows:—*A. siculiformis*, *A. diffusa*, *A. undulifolia*, *A. verniciflua*, *A. falcata*, *A. penninervis*, *A. obtusata*(?), *A. rubida*, *A. linifolia* var.(?), *A. lunata*, *A. lunata* var., *A. melanoxylon*, *A. decurrens*, *A. dealbata*, *A. Dawsoni*.

A. doratoxylon A. Cunn., the Currawong of western New South Wales, has been identified from specimens obtained about 16 miles southerly from Dalgety in the vicinity of Popong. The occurrence of this species in such a cold locality is most remarkable. It was pointed out to me, in 1898, as Myall.

List of Eucalypts.

The Eucalypts noticed were as follows:—*E. stellulata*, *E. Moorei*, *E. coriacea*, *E. amygdalina*, and var. *nitida* (?), *E. dives*, *E. macrorrhyncha*, *E. haemastoma*, *E. fraxinoides*, *E. pulvigera*, *E. viminalis*, *E. Bridgesiana*, *E. rubida*, *E. maculosa*, *E. fastigata*, *E. Sieberiana*, *E. parvifolia*, n.sp. *E.* sp.,(No. 1980).

My thanks are due to Messrs J. H. Maiden, F.L.S., and E. Betche for assistance in identifying some of the plants. I am also indebted to Miss E. Tivey, who supplemented my collection of specimens, and to Mr. Alfred Tivey for affording facilities for visiting the Kybean River, and also for procuring leaves of *Eucalyptus parvifolia* for distillation.

EXPLANATION OF PLATE XXX.

Seedlings of *Eucalyptus pulvigera* A. Cunn., grown from seed collected at Cox's River, in October, 1904; flowering, March, 1908.

DESCRIPTION OF A NEW SPECIES OF EUCALYPTUS FROM THE MONARO DISTRICT, N.S.W.

By R. H. Cambage, F.L.S.

(Plates xxviii.-xxix.)

Eucalyptus parvifolia, n.sp.

Arbor parva, umbrosa, alta pedes viginti trigintavə (raro quadraginta), trunci diametro unciarum duodecim ad duodeviginti. *Folia tenera* ovata nec longiora una uncia, opposita, decussata, superficie inferiore pallida, nec alia plerumque folia sunt arboribus minoribus quam decem ad duodecim pedes. *Folia matura* lineali-lanceolata ad ovato-lanceolata, longa uncias duas et dimidium, sæpe opposita, plerumque adunca ad extremum. *Gemmæ* sessiles, parvæ, operculo conicali ad obtusum, breviore quam calycistubus, pedunculis axillaribus, planatis sæpe oppositis, longis circiter unam lineam. *Flores* in umbella quinque sexve, raro septem. Antheris versatilibus mediocri magnitudine, cellis fere parallelis, paulo latioribus ad imum, glande parva. *Fructus* globoso-truncatus, diametro raro plus quam duarum linearum, interdum contractior ad orificium, valvis non exsertis. *Cortex* levis, colore cinereo vel plumboso. *Materia* colore roseo, mollis et fragilior.

Loc.—Regio plana prope fontem fluminis Kybeani.

A small umbrageous tree reaching 20-30 feet high, rarely 40 feet, with stem-diameter of 12-18 inches.

Juvenile leaves ovate, under 1 inch long, opposite, decussate, under side pale, usually the only foliage on trees up to 10-12 feet high. *Mature leaves* linear-lanceolate to ovate-lanceolate, up to

2½ inches long, often opposite, the tips usually hooked. *Buds* sessile. small, the operculum conical to obtuse, shorter than the calyx-tube, peduncles axillary, flattened, often opposite, about 1 line long. *Flowers* five or six in umbel, rarely seven. Anthers versatile, of medium size, the cells nearly parallel, rather broader at the base, small gland. *Fruits* globular-truncate, rarely exceeding 2 lines in diameter, sometimes slightly contracted at the orifice, valves not exserted. *Bark* smooth, dull gray to lead colour. *Timber* pale pink, soft and rather brittle.

Hab.—Flat land near the head of Kybean River.

Its affinities are with *E. acaciæformis* Deane and Maiden, *E. stellulata* Sieb., *E. aggregata* Deane and Maiden, and *E. eugenioides* Sieb., var. *nana* Deane and Maiden.

It differs from both *E. acaciæformis* and *E. aggregata* in the bark, which is fibrous, while that of *E. parvifolia* is smooth. The leaves of the former two soon become alternate, while many of those of the latter remain opposite, even when the trees are full-grown, or much longer than is usual with the great majority of Eucalypts.

It is of interest to note that *E. aggregata* is associated with *E. stellulata* from the Lithgow-Orange district in the north, to the upper part of the Shoalhaven River in the south, between Braidwood and Cooma, but has not been recorded from Monaro. On the Upper Kybean, however, *E. parvifolia* appears to take the place of *E. aggregata*, with which it has considerable affinities, and occurs in similar situations to *E. stelullata*.

E. parvifolia resembles *E. stellulata* in bark (partly), fruits and habit, but differs absolutely in foliage, both as regards venation and disposition.

It resembles *E. eugenioides* var. *nana* in the shape of the juvenile foliage and fruits, but differs in bark, timber, anthers, and mature foliage.

The retention of a very large proportion of the small oppositely arranged leaves on mature trees is one of the most striking characteristics of this new species, hence the specific name.

Leaves of this Eucalyptus were procured and distilled at the Technological Museum. Messrs. Baker and Smith report on the oil as follows :

The oil obtained from the leaves of this species by steam-distillation is of excellent quality, and consists very largely of eucalyptol. In its general characters it corresponds to the essential oils obtained from the members of the "Gum-Group" of Eucalypts, and, therefore, closely approximates to the oil distilled from *Eucalyptus globulus*, although it is even richer in eucalyptol than the oil from that species The rectified oil is slightly yellowish, and, as is common with the crude oils of this group, contains a small amount of volatile aldehydes. The amount of ester present was but small. The oil contained a small quantity of dextrorotatory pinene, but phellandrene was quite absent. No less than 93 per cent. of the crude oil distilled between 167° and 190°C., and in this fraction the eucalyptol was determined by the resorcinol method, and calculated for the crude oil. The yield of oil is unfortunately not great, and 271 lbs. of leaves with terminal branchlets gave only 29½ ounces of oil, equal to 0·681 per cent. When rectified, the oil from this species would produce an excellent oil for pharmaceutical purposes.

The crude oil had the following characters :—

Specific gravity at 15°C.=0·9177

Rotation a_D in a 1-dcm. tube= + 3·6°.

Refractive Index at 25° C.=1·4678.

Soluble in 1·15 volumes 70 per cent. alcohol by weight.

Saponification number of ester with free acid=5·6

If calculated entirely as ester there was 1·96 per cent. considered as geranyl acetate.

Eucalyptol (by the resorcinol method)=83 per cent.

The large fraction (93 per cent.) had specific gravity at 15° = 0·9155; rotation a_D + 3·5°; refractive index at 27° = 1·4651. It was soluble in 1·1 volume of 70 per cent. alcohol.

On continuing the distillation, 2 per cent. of a yellow oil came over between 225° and 235°C. This had specific gravity 0·9285 at 15°, and a refractive index above 1·51. It had an odour somewhat indicating aromadendral, but when dissolved in chloroform it was dextrorotatory, thus differing from that substance.

EXPLANATION OF PLATES XXVIII.-XXIX.

Eucalyptus parvifolia, sp.nov.(Small-leaved Sally).

Plate xxviii.

Fig. A.—Leaves of seedling.
Fig. B.—Leaves and buds of mature branch.
Fig. C.—Fruiting specimen, showing mature leaves.
Fig. D.—Anthers (enlarged).
Figs. A. and B. nat. size. Fig. C. approximately half nat. size.

Plate xxix.

Group of trees; Kybean, N. S. W.

WEDNESDAY, JULY 26TH, 1909.

A Special General Meeting, together with the Ordinary Monthly Meeting of the Society were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, July 28th, 1908.

Mr. C. Hedley, F.L.S., President, in the Chair.

SPECIAL GENERAL MEETING.

Business: To confirm the amendments of Rules ii., iii., iv., vi., viii., and xlvii., with a view to the admission of Women to full Membership.

On the motion of Mr. Henry Deane, seconded by Mr. R. J. Tillyard, it was resolved, that the amendments of the Rules specified, passed at last Meeting, be confirmed.

On the motion of Mr. A. H. S. Lucas, seconded by Dr. H. G. Chapman, it was resolved, that the existing Associate Members be recognised forthwith as Ordinary Members.

ORDINARY MONTHLY MEETING.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 13 Vols., 77 Parts or Nos., 24 Bulletins, 6 Reports, 7 Pamphlets, and 4 Maps, received from 62 Societies, &c., were laid upon the table.

NEW AUSTRALIAN LEPIDOPTERA BELONGING TO THE FAMILY *NOCTUIDÆ*.

A. Jefferis Turner, M.D., F.E.S.

Section Hadeninæ.

Borolia microsticta,* n.sp.

♀. 28 mm. [Head missing]. Thorax ochreous-whitish. Abdomen whitish. Legs whitish, anterior pair with some fuscous suffusion. Forewings elongate, costa very slightly arched, apex rounded, termen obliquely rounded; ochreous-whitish; a whitish streak along lower edge of cell, continued towards termen along veins 4 and 5; two minute black dots just above this, one in middle and one in end of cell, and a slight fuscous suffusion in bifurcation; a terminal series of black dots; cilia whitish-ochreous. Hindwings with termen sinuate; white; a scanty fuscous suffusion near termen; some fuscous terminal dots; cilia white.

Type in Coll. Turner.

N.Q.: Townsville; one specimen.

Section Acronyctinæ.

Trachea albidisca.

Q.: Brisbane; one example in the Queensland Museum.

Euplexia polycmeta.

N.S.W.: Lawson, Blue Mountains. The locality given by Hampson (Cat. Lep. Phal. vii. p.248) is incorrect.

Perigea aroana.

Perigea aroana Bak., Nov. Zool. xiii. p.194 (1906).

Perigea confundens Hmps., Cat. Lep. Phal. vii. p. 331., *nec* Wlk., Char. Undesc. Lep. p.69.

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* μικροστικτος, with small spots.

N.Q.: Thursday Island, Cairns, Atherton, Townsville—Q.: Brisbane. Also from New Guinea.

ERIOPUS TRILINEATA.

Q.: Brisbane.

ERIOPUS MAILLARDI.

N.Q.: Townsville.

AUCHA TRIPHÆNOIDES.

The West Australian locality is an error.

HYPOPERIGEA HÆMORRHANTA,* n.sp.

♂. 28 mm. Head and thorax dark fuscous mixed with pale reddish. Frons very prominent, with a central acute process surrounded by a circular groove and outer ridge. Palpi 1, slender, porrect; ochreous. Antennæ whitish-ochreous; in ♂ with short ciliations ($\frac{1}{2}$) and longer bristles (1). Abdomen pale ochreous irrorated with fuscous; a pale fuscous tuft on basal segment. Legs whitish-ochreous mixed with fuscous. Forewings elongate-triangular, costa nearly straight, apex round-pointed, termen bowed, oblique; dark fuscous mixed with pale red; an obscure dentate transverse line at $\frac{1}{4}$; a similar line just beyond middle, traversing a reddish spot, which appears to represent reniform; a suffused reddish streak along fold; terminal area paler, and bounded anteriorly by an obscure dentate line; a strongly crenate dark fuscous line touching termen on crenations; cilia reddish mixed with fuscous. Hindwings with termen rounded; fuscous; cilia whitish-fuscous.

Type in Coll. Turner.

Q.: Adavale (far west); in March; one specimen.

PROMETOPUS PASSALOTA†, n.sp.

♀. 26 mm. Head and palpi dark fuscous mixed with whitish. Thorax dark fuscous; tegulæ with anterior edge brownish,

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*αἱμορραντος, blood-stained.

† πασσαλοτος, peg-marked.

posterior edge whitish. Abdomen pale fuscous, apices of segments whitish-ochreous. Legs dark fuscous mixed with whitish; posterior pair mostly whitish. Forewings elongate-triangular, costa gently arched, apex rounded, termen obliquely rounded; dark fuscous with a few brownish scales; a blackish streak from base along fold to $\frac{1}{4}$; a small circular ochreous spot, representing orbicular, at $\frac{1}{4}$, contained in a wedge-shaped blackish streak with apex anteriorly; this streak is abruptly followed by a wedge-shaped ochreous blotch, its apex at $\frac{5}{6}$ and its posterior edge finely dentate; a terminal paler brownish-fuscous fascia limited anteriorly by a wavy line; cilia brownish-fuscous with obscure darker bars. Hindwings with termen rounded, slightly wavy; fuscous; cilia whitish with a fuscous basal line not reaching tornus. Underside of forewings fuscous; of hindwings whitish with a central fuscous dot and apical fuscous blotch.

Type in Coll Turner.

V.: Birchip; in April; one specimen received from Mr. D. Goudie.

Section **Stictopterinæ**.

GYRTONA LOPHOTA,* n.sp.

♂. 22 mm. Head, palpi, and thorax fuscous-brown. Antennæ dark fuscous. Abdomen fuscous. Legs fuscous-brown with whitish annulations. Forewings elongate, posteriorly strongly dilated, apex rounded, termen scarcely oblique, rounded beneath; fuscous-brown irregularly mixed with whitish; a roundish dark spot on base of costa; several transverse lines in basal $\frac{1}{4}$, the last being occupied by a very prominent ridge-like crest in disc; median area of disc suffused with whitish containing several indistinct transverse lines, this suffusion prolonged to tornus and lower part of termen; two closely parallel dentate fuscous-brown lines at $\frac{3}{4}$, succeeded by a similar single line; a dark apical blotch traversed by a whitish dentate subterminal line; an interrupted brown line close to termen; cilia brown-whitish. Hindwings with termen wavy; fuscous, towards base whitish; cilia whitish with a fuscous basal line.

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* λοφωτος, crested.

Type in Coll. Turner.

N.Q.: Kuranda; in September and December; two specimens received from Mr. F. P. Dodd.

Section Sarrothripinæ.

SARROTHRIPA ABSTRUSA,* n.sp.

♀. 22 mm. Head fuscous. Palpi 3½; fuscous with white irroration. Antennæ dark fuscous. Thorax and abdomen pale fuscous. Legs fuscous mixed with whitish; posterior pair whitish. Forewings oblong, costa strongly arched at base, thence nearly straight to near apex, apex rounded, termen obliquely rounded; whitish mixed with brownish-fuscous; a short greenish streak from base of costa parallel to dorsum; a large circular blackish spot in middle of disc near base; five short broad oblique fuscous streaks on costa; from the first of these arises a fine, slightly dentate, fuscous median line to dorsum; from the third a similar postmedian line; some subcostal fuscous suffusion between these lines; a subterminal series of fuscous dots increasing in size towards tornus; an interrupted fuscous terminal line; cilia pale brownish-fuscous. Hindwings with termen slightly sinuate; fuscous; cilia fuscous, apices whitish.

Type in Coll. Turner.

N.Q.: Kuranda; in September; one specimen received from Mr. F. P. Dodd.

Section Acontianæ.

CACYPARIS MELANOLITHA,† n.sp.

♂♀. 23-38 mm. Head and thorax ochreous-fuscous with an unctuous gloss. Palpi ochreous. Antennæ fuscous; ciliations in ♂ 1½. Abdomen deep yellow. Legs ochreous. Forewings oval, costa very strongly arched, apex rounded, termen gently rounded, oblique; ochreous-fuscous; base suffused with unctuous scales; a round crest of black scales on middle of dorsum; an

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* Abstrusus, concealed.

† μελανολιθος, black-jewelled.

oblique line of unctuous scales from $\frac{1}{4}$ costa to mid-termen; two short outwardly oblique similar streaks from costa at middle and $\frac{3}{4}$; an oval black subapical spot outlined with ochreous, and divided by a fine ochreous line into a larger upper and smaller lower segment; cilia ochreous-fuscous with an unctuous basal line. Hindwings with termen rounded; deep yellow; a large roundish dark fuscous spot near apex : cilia yellow.

Type in Coll. Turner.

N.Q.: Kuranda; from October to January; five specimens received from Mr. F. P. Dodd.

Section **Homopterinæ**.

CALLIODES XANTHOPYGA,* n.sp.

♂. 67 mm. Head, palpi, and antennæ reddish-brown; antennal pectinations 3. Thorax fuscous; tegulæ reddish-brown. Abdomen dark fuscous at base, apical half ochreous, tuft fuscous at base; underside ochreous. Legs ochreous; anterior and middle tibiæ and tarsi fuscous. Forewings triangular, costa moderately arched, apex round-pointed, termen bowed, oblique; fuscous-brown mixed with whitish; a dark fuscous dentate line from costa near base to base of dorsum; a similar roughly parallel line from $\frac{1}{4}$ costa to $\frac{1}{5}$ dorsum, forming the anterior edge of a broad median fuscous band; a transversely oval ocellus lies on the posterior edge of this band, outlined with black, internally greenish, containing two black spots united anteriorly by a whitish line; beyond this band is a narrow whitish band containing a dentate brownish line from $\frac{2}{3}$ costa to $\frac{3}{5}$ dorsum; an indistinct darker shade beyond this, dentate posteriorly; two parallel crenate fuscous subterminal lines; cilia brownish. Hindwings with termen rounded; dark fuscous-brown; a transverse whitish band; subterminal lines and cilia as forewings. Underside ochreous with large oval median blackish spots, dentate postmedian lines. and suffused fuscous terminal bands on fore and hindwings.

Type in Coll. Turner.

N.Q.: Ingham; one specimen from Mr. McKie's collection.

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* ξανθοπυγος, yellow-rumped.

THYAS DICOELA,* n.sp.

♂. 48 mm. Head, palpi, and thorax fuscous-brown. Antennæ brown; in ♂ minutely ciliated. Abdomen fuscous. Legs fuscous; all femora and tibiæ in ♂ densely clothed with long hairs. Forewings triangular, costa very slightly arched, apex round-pointed, termen bowed, oblique, crenulate; dark fuscous-brown; costal edge paler; a transverse antemedian white fascia, suffused with purple-fuscous towards extremities, sharply defined, both edges evenly concave; a sharply defined pale apical patch with curved outline, ending in a dark apical and smaller subapical tooth; a sharply defined line from middle of apical patch to $\frac{3}{4}$ dorsum; beyond this disc is paler, becoming whitish towards termen; an indistinct fine whitish dentate subterminal line; a fine fuscous terminal line; cilia pale fuscous. Hindwings with termen rounded, crenulate; fuscous, on termen mixed with whitish; a white streak from $\frac{2}{3}$ dorsum half across disc; terminal line and cilia as forewings.

From *Thyas constricta* Butl., to which it is allied, this may be distinguished by the narrower fascia of forewing, differently shaped apical blotch, and more hairy legs of ♂.

Type in Coll. Turner.

N.Q.: Cairns; one specimen.

THYAS CRIMNOPASTA,† n.sp.

♀. 28 mm. Head, thorax, and abdomen fuscous with some whitish irroration. Palpi fuscous; second joint, except at apex, irrorated with whitish-ochreous. Antennæ dark fuscous. Legs fuscous irrorated with whitish. Forewings triangular, costa straight except near apex, apex pointed, termen bowed, oblique, crenulate; fuscous; a basal patch of rather dense white irroration, a similar fascia at $\frac{1}{3}$, rather broad, edges irregularly dentate; a dark fuscous line from $\frac{2}{3}$ costa towards tornus, forming an acute angle in middle, and ending on $\frac{3}{4}$

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* δικοιλος, biconcave.

† κριμνοπαστος, flour-sprinkled.

dorsum; a band of whitish irroration from costa above this to termen near tornus, and a smaller subapical band confluent with it; a small dark fuscous spot above tornus; cilia fuscous mixed with whitish. Hindwings with termen rounded, crenulate; dark fuscous; a whitish line from dorsum just above tornus to middle of disc; and a shorter whitish suffusion from tornus along termen; cilia fuscous mixed with white, between veins 5 and 7 wholly white. Underside of wings uniformly fuscous except cilia, which resemble upper side.

Type in Coll. Turner.

N.Q.: Townsville; one specimen.

Section **Noctuinæ**.

Bocula odontosema,* n.sp.

♂. 35 mm. Head, palpi, antennæ, thorax, and abdomen pale brownish-ochreous. Antennæ in ♂ with tufts of cilia ($1\frac{1}{2}$). Abdominal tuft in ♂ much exaggerated. Legs fuscous; posterior pair pale ochreous; posterior tibiæ with a dorsal fringe of long hairs in ♂. Forewings broadly triangular, costa scarcely arched, apex rounded, termen long, deeply bowed, dorsum short; pale brownish-ochreous; a median dark fuscous dot towards costa; a sharply defined postmedian dark fuscous blotch, anteriorly rounded, posteriorly with four sharp teeth, the first and third longest; a small suffused apical dark fuscous spot; a terminal series of dark fuscous dots on veins; cilia concolorous. Hindwings of ♂ aborted towards apex with neuration distorted; ochreous-whitish.

Type in Coll. Turner.

N.Q.: Kuranda, in September; one specimen received from Mr. F. P. Dodd.

Capnodes silignia,† n.sp

♀. 40 mm. Head pale ochreous, face purple. Palpi long, recurved, second joint reaching vertex, terminal joint nearly as

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* ὀδοντοσημος, tooth-marked.

† σιλιγνιος, floury.

long as second, stout, obtuse; purple mixed with fuscous and whitish, apex whitish. Thorax and abdomen ochreous-fuscous, purplish-tinged; legs fuscous-purple mixed with whitish-ochreous; posterior pair whitish-ochreous; anterior and middle tarsi dark fuscous annulated with white. Forewings triangular, apex pointed, termen strongly bowed, slightly oblique, crenulate; ochreous-fuscous tinged with purplish; traces of a transverse line at $\frac{1}{5}$; two white dots in disc before this line; two white dots on costa near base, and four towards apex; an irregularly dentate line at $\frac{2}{3}$, traversing a large whitish suffusion, broadest on dorsum and not reaching costa; short whitish streaks between veins ending in fuscous terminal dots; cilia concolorous. Hindwings with termen rounded, crenulate; colour and cilia as forewings; a suffused whitish blotch above tornus.

Type in Coll. Turner.

N.Q.: Kuranda; in November; one specimen, received from Mr. F. P. Dodd.

MECODINA ZOPHEROPA,* n.sp.

♀. 47 mm. Head, palpi, thorax, abdomen, and legs fuscous-brown. Antennæ fuscous. Forewings elongate-triangular, costa gently arched, apex round-pointed, termen scarcely oblique, bowed, crenulate; fuscous-brown; indications of a dentate transverse line at $\frac{1}{4}$; two whitish dots placed transversely just beyond middle; a postmedian pale fuscous shade traversed by a fine dentate fuscous-brown transverse line; cilia concolorous. Hindwings with termen wavy; fuscous; cilia fuscous.

Type in Coll. Turner.

N.Q.: Kuranda; in December; one specimen received from Mr. F. P. Dodd.

ZETHES TEPHRAEA,† n.sp.

♂. 32 mm. Head and thorax grey. Palpi grey mixed with whitish. Antennæ ochreous-whitish. Abdomen grey with white

* ζοφερωπος, dusky.

† τεφραῖος, ashy.

irroration. Legs whitish. Forewings elongate-triangular, costa nearly straight, apex rectangular, termen crenulate, acutely angled on vein 4; ashy-grey with a few scattered fuscous scales; two fine dentate fuscous lines at $\frac{2}{3}$ and $\frac{5}{6}$; a submarginal series of fuscous dots between veins; a fine fuscous terminal line; cilia grey. Hindwings with termen crenulate, not rounded; colour and markings as forewings.

Type in Coll. Turner.

N.Q: Kuranda; in October; one specimen received from Mr. F. P. Dodd.

ZETHES SHIVULA.

Marmorinia shivula Gn., Noct. iii., p.372.
Zethes xylochroma Wlk., Cat. Brit. Mus. xv., p.1525.
Egnasia grisangula Hmps., Ill. Het. viii., p.90.
Zethes adoxopis Turn., Trans. R. Soc. S. Aust. 1908, p.68.

Section **Erastrianae**.

ERASTRIA CLANDESTINA*, n.sp.

♂. 26 mm. Head, palpi, and thorax brownish-fuscous. Antennæ fuscous; in ♂ thickened and pale ochreous beneath with very short ciliations ($\frac{1}{4}$). Abdomen fuscous; with crests on dorsum of four basal segments. Legs brownish-fuscous; posterior pair paler. Forewings elongate-triangular, costa gently arched, apex rounded, termen obliquely rounded; brownish-fuscous; a thick, broken, transverse, dark fuscous line near base; indications of two very fine dentate postmedian lines, partly edged with whitish, but for the most part not traceable; cilia brownish-fuscous with a basal series of minute whitish dots. Hindwings with termen rounded; grey; cilia grey.

Type in Coll. Turner.

N.Q.: Kuranda; in September; one specimen received from Mr. F. P. Dodd.

TARACHE XUTHOSOMA,† n.sp.

♂♀. 15-18 mm. Head and palpi pale ochreous-yellow, the latter with some dark fuscous scales. Antennæ fuscous; ciliations in

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* Clandestinus, hidden.

† ξουθοσωμος, with yellowish body.

♂ minute. Thorax dark fuscous with a pale ochreous-yellow central spot; tegulæ pale ochreous-yellow with dark fuscous centre. Abdomen pale ochreous-yellow. Legs fuscous; posterior pair whitish. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; white, markings dark fuscous; a triangular spot at base of costa; a broad fascia at $\frac{1}{3}$, narrowing on dorsum, its centre with some white suffusion; a curved postmedian line in disc not reaching either margin; a broad fascia just beyond this, its posterior edge showing two broad projections above and below middle, the former more prominent; a terminal series of oval dots; cilia white. Hindwings with termen rounded; fuscous; cilia whitish.

Var.—White markings largely suffused with dark fuscous (Port Darwin).

Type in Coll. Turner.

N.A.: Port Darwin—N.Q.: Stannary Hills, Kuranda; in March and July; five specimens.

TARACHE PINODES,* n.sp.

♂. 16 mm. Head, palpi, thorax, and abdomen fuscous. Antennæ fuscous; ciliations in ♂ $\frac{2}{3}$. Legs fuscous irrorated, and tarsi annulated, with ochreous-whitish. Forewings elongate-triangular, costa slightly arched, apex round-pointed, termen slightly bowed, oblique; pale fuscous; markings dark fuscous irregularly edged with pale reddish-brown; a wavy transverse line at $\frac{1}{4}$; a line from mid-costa to $\frac{3}{4}$ dorsum; a line from $\frac{3}{4}$ costa curved first outwards and then inwards to join preceding line; a circular whitish orbicular spot between first and second lines; a whitish reniform spot following second line; a spot on costa beyond third line; some longitudinal pale reddish-brown streaks between third line and termen; a dark fuscous terminal line; cilia fuscous, apices whitish. Hindwings with termen sinuate; grey; cilia whitish with a grey basal line.

Type in Coll. Turner.

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* πινώδης, squalid.

N.A.: Port Darwin; in January—N.Q.: Townsville; in January; two specimens received from Mr. F. P. Dodd.

CORGATHA ANTHINA,* n sp.

♂. 18-20 mm. Head and thorax ochreous-fuscous. Palpi ochreous-fuscous irrorated with white. Antennæ whitish-grey; ciliations in ♂ $\frac{1}{2}$. Abdomen pale ochreous, with some reddish irroration on dorsum of basal segments. Legs pale fuscous irrorated with white; posterior pair reddish irrorated with white. Forewings triangular, costa slightly arched, apex pointed, termen angled on vein 4, somewhat excavated above and below angle; reddish; costa suffused with fuscous; four somewhat dentate fuscous transverse lines, first from $\frac{1}{4}$ costa to $\frac{1}{4}$ dorsum, second from $\frac{2}{5}$ costa to $\frac{2}{5}$ dorsum; third from $\frac{2}{3}$ costa to $\frac{3}{5}$ dorsum, angulated in disc, and with a few whitish scales on posterior edge; fourth subterminal, rather indistinct; white dots on costa at origins of second, third, and fourth lines; a short transverse fuscous linear mark in disc between second and third lines; a fuscous terminal line; cilia orange-yellow, on costa, apex and angle reddish. Hindwings with termen scarcely rounded; as forewings but with one basal line and a median fuscous fascia.

Var.—All fuscous markings nearly obsolete; forewings ochreous-grey contrasting with reddish hindwings; white dots on third transverse line well marked.

Type in Coll. Turner.

Q.: Toowoomba; in January (type): Bunya Mountains; in December (var.): two specimens.

MICRÆSCHUS NIVICEPS,† n.sp.

♂. 14 mm. Head snow-white, posterior part reddish; face and palpi brownish-ochreous. Antennæ white; ciliations in ♂ $1\frac{1}{2}$. Thorax and abdomen reddish. Legs whitish-ochreous Forewings triangular, costa straight to near apex, apex acute, termen

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*ἀνθινος, flowery.

†Niviceps, with snow-white head.

strongly bowed, oblique; reddish; costa suffused with fuscous; a reniform fuscous spot beneath mid-costa; a fine dentate postmedian line from $\frac{2}{3}$ costa outwards, then angled to dorsum near middle; a fuscous terminal line; cilia reddish. Hindwings with termen rounded; as forewings.

Var.—Whole of disc between postmedian line and termen of both wings suffused with fuscous.

Type in Coll. Turner.

N.Q.: Kuranda; in December; two worn specimens received from Mr. F. P. Dodd.

EUBLEMMA LOXOTOMA*, n.sp.

♂♀. 25-28 mm. Head and palpi ochreous-fuscous. Antennæ ochreous-fuscous, towards apex dark fuscous. Thorax whitish-grey tinged with purple. Abdomen ochreous-fuscous. Legs ochreous-fuscous; tarsi with narrow white annulations. Forewings triangular, costa straight, apex acute, termen bowed, slightly oblique, slightly crenulate; whitish-grey tinged with purple; an ochreous-fuscous straight streak from apex to mid-dorsum, preceded by some ochreous-fuscous suffusion in disc; costal edge ochreous; three fine ochreous-fuscous lines; first dentate, outwardly curved, at $\frac{1}{4}$; second straight, from mid-costa very obliquely outwards to streak; third from $\frac{3}{4}$ costa parallel to second as far as streak, thence continued as an irregularly dentate line to $\frac{3}{4}$ dorsum; fine lines along veins between this and termen; a fine terminal line; cilia ochreous-fuscous, apices purple-fuscous. Hindwings with termen slightly rounded; colour as forewings; streak represented by an antemedian line; an evenly dentate fine subterminal line.

Closely allied to *E. versicolor* Wlk., of which it might be taken for a variety; but, in addition to the larger size and different coloration, the subterminal lines, especially of the hindwings, are more evenly dentate.

Type in Coll. Turner.

N.Q.: Townsville; in July; two specimens received from Mr. F. P. Dodd.

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* λοξοτομος, obliquely divided.

EUBLEMMA APLECTA,* n.sp.

♀. 22 mm. Head and thorax whitish-grey. Palpi fuscous; internal and upper surface of second joint whitish-grey. Antennæ whitish-grey. Abdomen grey. Legs whitish-grey; posterior pair whitish. Forewings triangular, costa straight, apex obtuse, termen strongly bowed in apical half, slightly oblique; whitish-grey with some brownish-ochreous irroration; costa brownish-ochreous; an obscure fuscous apical spot; cilia whitish-grey [abraded]. Hindwings with termen rounded; pale grey with slight ochreous tinge; cilia whitish-grey.

Type in Coll. Turner.

Q.: Gympie; in April; one specimen.

ZOPHOCHROA PSOLOESSA,† n.sp.

♂. 20 mm. Head and thorax dark fuscous. Palpi $2\frac{1}{2}$; dark fuscous. Antennæ fuscous; pectinations in ♂ 6. Abdomen fuscous; a dark fuscous crest on dorsum of basal segment. Legs fuscous. Forewings triangular, costa scarcely arched, apex rounded, termen bowed, oblique; dark fuscous; an ochreous-whitish dot in disc at $\frac{1}{4}$; a dentate blackish line at $\frac{2}{3}$, its posterior edge partly outlined with ochreous-whitish, which forms a distinct spot on dorsum; a subterminal series of minute ochreous-whitish dots; cilia dark fuscous. Hindwings with termen rounded; fuscous: cilia fuscous.

Type in Coll Turner.

N.Q.: Kuranda, in October; two specimens received from Mr. F. P. Dodd.

Section **Hypeninæ**.

Gen. SAROPTILA,‡ n.g.

Frons rounded, not projecting. Tongue well developed. Palpi recurved, second joint stout, appressed to frons, reaching vertex; terminal joint less than $\frac{1}{2}$ second, rather slender, acute. Antennæ

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* ἀπλεκτος, simple.

† ψολοεις, sooty.

‡ σαροπτιλος, brush-winged.

of ♂ evenly ciliated, with a pair of bristles on each joint. Thorax and abdomen smooth, legs normal. Forewings of ♂ with a large tuft of long hairs from cell on undersurface; areole absent, 7 free, 8, 9, 10 stalked. Hindwings of ♂ with a hairy patch on under side; 3 and 4 stalked, 5 straight from rather below middle of cell.

Type, *S. milichias* Turner.

SAROPTILA MILICHIAS,* n.sp.

♂. 26 mm. Head, palpi, thorax, and abdomen whitish-brown. Antennæ whitish-brown; ciliations in ♂ 1¼, bristles 2½. Legs whitish-brown. Forewings triangular, costa gently arched, apex rectangular, termen bowed, slightly oblique; in ♂ with a patch of long hairs from under side of cell, more or less covered by costal expansion of hindwing; whitish-brown; a white dot in middle, and another at end of cell; a slight ferruginous suffusion between second dot and tornus; cilia whitish. Hindwings in ♂ with a large costal expansion and truncate apex, a dense hairy ridge from beyond middle of costa in a straight line nearly to mid-termen; whitish-brown; costal half thinly scaled, whitish, translucent; cilia whitish.

Type in Coll. Turner.

N.Q.: Kuranda; in October; one specimen received from Mr. F. P. Dodd.

SAROPTILA MEGALOSARA,† n.sp.

♂. 25 mm. Head, palpi, thorax, abdomen, and legs fuscous-brown. Antennæ ochreous-whitish with fuscous irrorations; in ♂ ciliations 1, bristles 1½. Forewings triangular, costa nearly straight, towards apex wavy; apex acute, termen strongly bowed, scarcely oblique; in ♂ with a patch of very long hairs from cell beneath; fuscous-brown tinged with ferruginous; a whitish dot in middle, and another in end of cell; immediately above the latter a small ferruginous reniform spot; cilia fuscous-whitish.

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* μειλιχιος, gentle.

† μεγαλοσαρος, with large brushes.

Hindwing in ♂ with costal expansion, truncate apex, and rounded termen, a round patch of dense moderately long hairs beneath costa a little beyond middle; fuscous-brown, paler towards dorsum; a costal patch bare of scales on upper side only and not extending to apex; cilia fuscous-brown.

Allied to the preceding species, but immediately distinguishable by the differently shaped hairy patch on under side of hindwing.

Type in Coll. Turner.

N.Q.: Kuranda; in April; one specimen received from Mr. F. P. Dodd.

PANILLA DENTILINEA,* n.sp.

♀. 35 mm. Head and palpi ochreous-whitish mixed with fuscous and reddish. Antennæ fuscous, towards base pale reddish barred with blackish. Thorax and abdomen ochreous-whitish mixed with fuscous and pale reddish. Legs ochreous-whitish, anterior and middle pair suffused, and tarsi annulated, with fuscous, anterior tibiæ irrorated with reddish scales. Forewings triangular, costa scarcely arched, apex rounded, termen bowed, oblique, crenulate; brown-whitish mixed with fuscous, which forms darker markings; some reddish scales near base; a broad ill-defined transverse line near base; a still less distinct line before middle; a fine acutely dentate line, the dentations capped with whitish dots, at $\frac{2}{3}$; a faintly marked pale acutely dentate sub-terminal line; short fuscous longitudinal streaks to termen between veins; cilia ochreous-whitish mixed with fuscous and reddish. Hindwings with termen rounded, crenulate; colour and markings as forewings.

Type in Coll. Turner.

N.Q.: Kuranda, in May; one specimen received from Mr. F. P. Dodd.

CHUSARIS OPISTHOSPILA,† n.sp.

♂♀. 15-16 mm. Head and thorax whitish; face and palpi dark fuscous. Antennæ dark fuscous; ciliations in ♂ $\frac{2}{3}$. Abdomen

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* Dentilineus, with toothed line.

† ὀπισθοσπιλος, with posterior spot.

whitish with a few fuscous scales. Legs whitish irrorated with fuscous. Forewings triangular, costa scarcely arched, apex round-pointed, termen bowed, oblique; whitish with dark fuscous markings; a suffused streak along costa to $\frac{3}{5}$; a dot touching this near base; an interrupted transverse line at $\frac{1}{5}$; a suffused fuscous transverse shade before middle, succeeded by a short dark fuscous linear mark in middle; a line from $\frac{3}{5}$ costa curved strongly outwards and then inwards, ending on $\frac{3}{5}$ dorsum; an interrupted terminal line; cilia whitish. Hindwings with termen scarcely rounded; whitish; a dark fuscous spot on dorsum above tornus; cilia whitish.

Type in Coll. Turner.

N.Q.: Kuranda; in October and November; three specimens received from Mr. F. P. Dodd.

NOTES FROM THE BOTANIC GARDENS, SYDNEY.

No. 14.

By J. H. Maiden and E. Betche.

(Plates xxxi.-xxxii.)

RUTACEÆ.

Atalantia glauca Hook. f.

Dubbo district (C. Marriott, District Forester; January, 1909).

The fruits are described as globular, about ½ inch in diameter, and all fruits we have previously seen agree well with this description. Mr. Marriott's specimens include some pear-shaped ones attaining nearly 1 inch in length. This seems to be merely variation in the shape of the fruit; the leaves are exactly as in the typical form; flowers we have not yet seen.

LEGUMINOSÆ.

Isotropis atropurpurea F.v.M.

Denman (W. Heron; September, 1908).

We published this plant as new for New South Wales in these Proceedings, xxxiii., p.307, 1908, the localities given being Bingara and Manilla. We are now able to add a third New South Wales locality. Mr. Heron writes:—"It is not very common in this part; it grows from 3 to 4 feet high."

Pultenæa cinerascens Maiden and Betche.

Coonabarabran, Forked Mountain, Timor Rock, Rocky Glen (J. L. Boorman; September, 1908).

Four new localities, in the same district, for a rare plant.

ACACIA DOROTHEA Maiden.

Since the publication of the description of this species in these Proceedings, xxvi., p.12, 1901, we have received numerous specimens from Blue Mountain localities, which do not much enlarge the very limited geographical range of the species, but which necessitate the transposition of the species into the Section *Julifloræ*. The new material, especially specimens in bud from Leura (A. A. Hamilton and others), show distinctly that the flowers are in short spikes, $\frac{1}{4}$-$\frac{1}{2}$ inch (5-11 mm.) long, though often appearing globular when in full flower.

This transposition makes the affinities of the species still more difficult to trace. There is not a single Acacia in *Julifloræ* with prominently 1-nerved phyllodia, so the species stands isolated in this Section. Its nearest affinities are doubtless in *Uninerves*, but in this Section it would stand isolated by its spike-like inflorescence.

The position of this Acacia is therefore one not free from doubt.

Bentham regarded the *phyllodia characters of primary importance*, and kept a number of Acacias with spicate inflorescence under the Section *Pungentes*. Mueller regarded the spicate inflorescence as of more importance than the phyllodia, and removed Bentham's spicate *Pungentes* to *Julifloræ*.

If we take Bentham's view, we must leave it in *Uninerves*. If we take Mueller's view, we must remove it to *Julifloræ*.

HALORRHAGACEÆ.

HALORRHAGIS LUCASI, n.sp. (Plate xxxi.)

Frutex erectus, lævis, glaber, infra 1 m. altus, ramis quadrangulis. Folia opposita, lanceolata, extenuata basi sed sessilia, 3·5-5 cm. longa, irregulariter serrata. Flores solitarii in brevibus pedicellis in axillis foliorum superiorum, vel terminales in brevibus axillaribus foliatis ramulis. Bracteolæ foliaceæ sessiles in pedicello juxta calycis basem. Calycis tubus lævis, quatuor longitudinalibus alis, lobis lato-triangulis, tubo circiter duplo brevioribus. Petala quatuor, alba, linearia, circiter 12 mm. longa et

4 mm. lata, carinis obtusis. Stamina octo, petalis subæquilongis; antheræ longæ, lineares, erectæ, duabus cellis, aperientes longitudinale. Styli quatuor. Ovarium quatuor cellis, pendulo ovulo in singulis cellis. Fructus (non visus maturus), ellipticus, cellis quatuor, lævis, 5-6 mm. longus, quatuor alis, alæ circiter 1½ mm. latæ.

Collected by Mr. A. H. S. Lucas, late President of this Society, "in a wild gully near Gordon, Port Jackson," November, 1908.

An erect bushy shrub under 3 feet high, smooth and glabrous in all its parts; the branches quadrangular and slightly winged by the decurrent bases of the leaves, leafless in the lower part but marked by scars of the fallen leaves. Leaves opposite, lanceolate, narrowed towards the base, but sessile and narrowly decurrent, 3½ to 5 cm. long except the upper shorter floral leaves, irregularly serrate, the teeth with reddish callous tips. Flowers solitary, shortly pedicellate in the axils of the upper leaves, or terminal on short axillary leafy shoots, the two bracteoles a short distance removed from the base of the calyx, minutely denticulate. Calyx-tube smooth, without any of the asperities so common in the genus, but with four longitudinal wings generally more or less undulate; calyx-lobes broadly triangular, alternating with the wings, rather above half as long as the tube. Petals 4, white, linear, about 12 mm. long and 4 mm. broad, bluntly keeled, alternating with the calyx-lobes. Stamens 8, nearly as long as the petals, the filaments less than ⅓ the length of the erect anthers; anthers linear, 2-celled, opening longitudinally. Styles 4, about 1½ to 2 mm. long, with papillose stigmas. Ovarium quite adnate to the calyx-tube, 4-celled, with a pendulous ovule in each cell. Fruit (not seen quite ripe) elliptical, smooth, 5 to 6 mm. long without the calyx-lobes, conspicuously 4-winged, the wings about 1½ mm. broad, 4-celled. Ripe seeds not seen.

This is the most handsome species of a genus consisting generally of insignificant looking plants with no claim to beauty. The smooth glossy foliage and the comparatively large white flowers make it quite worth cultivating. It is rather difficult to find its exact position in the system, as it differs so essentially from all other species known, but it belongs to Series iii. *Oppositiflorœ* of Bentham's system, and we propose to place it next to *H. monosperma* F.v.M.

MYRTACEÆ.

BAECKEA DENTICULATA, n.sp. (Plate xxxii.)

Frutex diffusus, glaber. Folia breviter petiolata, angusta ovata, 4-6 mm. longa et circiter 2-3 mm. lata, rotundata basi, denticulato-ciliata. Flores 2-8, terminales in axillis bractearum, vel rarius in axillis summorum foliorum. Pedicellis circiter æquilongis floribus, articulati super medium, duabus oppositis latis bracteis in articulo. Calycis tubus turbinatus, circiter 1½ mm. longus, brevibus triangulis lobis. Petala orbiculata, alba, lobis calycis circiter duplo longiora. Stamina 20-25 in ordine regulari; omnia filamenta filiformia; antheræ parvæ vix longiores quam latæ; duabus cellis, cellis parallelis, aperientes in duabus fissuris longitudinalibus. Ovarium tribus cellis, duabus collateralibus ovulis in singulis cellis.

Kybean, 3800 to 4000 feet high, near the Kydra Trigonometrical Station, east of Nimitybelle(R. H. Cambage; November, 1908).

A prostrate or diffuse shrub with terete branches, glabrous in all its parts. Leaves not dense, opposite, spreading, very shortly petiolate, narrow-ovate, 4 to 6 mm. long and about half as broad, rounded and broad at the base, more narrowed towards the top but not acute, flat or the margins slightly recurved, prominently denticulate-ciliate, rather paler underneath. Flowers white with the faintest tint of pink, terminal or the branchlets in the axils of the bracts forming umbels of 2 to 8 flowers, occasionally with branched rays, more rarely solitary and terminal or in the axils of the uppermost leaves. Pedicels mostly longer than, or as long as flowers, articulate above the middle, with two oppósite small broad bracts at the articulation. Calyx-tube turbinate, about 1½ mm. long, with short triangular lobes, faintly ciliate. Petals orbicular, about twice as long as the calyx-lobes. Stamens 20 to 25 in a regular row round the margin of the disk; filaments all filiform; anthers small, not much longer than broad, 2-celled, the cells parallel, opening in longitudinal slits. Ovarium 3-celled, with two collateral ovules in each cell. Fruits not seen.

The new species of *Baeckea* belongs to Bentham's Section ii. *Euryomyrtus*, and is sharply distinct from the few species in this Section in the broad, neatly ciliate leaves, and, above all, by the terminal inflorescence. The terminal inflorescence is unique in the genus, as far as we know, but it shows a state of transition from axillary to terminal inflorescence; the bracts supporting the rays of the terminal umbel are deformed leaves, and, therefore, the inflorescence might be described in other words: flowers axillary in the crowded uppermost leaves which are reduced to bracts.

COMPOSITÆ.

Olearia Flocktonæ, n.sp.

Dorrigo Table-land, on a clearing where *Fagus Moorei* formerly grew, within 2 miles of the east of the township (J. L. Boorman; March, 1909).

Fruticosus, dense ramosus, 1-1½ m. altus, partibus juvenilibus tectis capillis minutis crispatis non glutinosis. Folia linearia, conferta, 5-10 cm. longa, vix 5 mm. lata, marginibus recurvatis. Capitula radiata circiter 20-30, paniculo terminali corymbosoque. Involucrum hemisphæricum circiter 15 mm. transversim, squamis acutis. Flores radiales circiter 30, albi violaceo tincti. Styli appendices angustæ. Achenia omnia dense sericeo-pilosa; pappi setæ prope longitudine æquales.

An herbaceous plant attaining 4 to 5 feet in height, much branched from near the base, the stems unbranched till near the top and then branched again, terminating in the corymbose inflorescence, covered with minute crisped but scarcely glandular hairs, as is also the young foliage. Leaves linear, crowded, 2-4 inches long and $\frac{1}{5}$-$\frac{1}{8}$ inch broad, sessile, the prominent midrib on the underside running down the stems and giving them a striate, somewhat angular appearance, the margins recurved. Flower-heads rather large, about 20 to 30 in a terminal corymbose panicle, generally well above the leaves, the panicle-branches with few shorter floral-leaves passing into the distant small bracts on the peduncles. Involucre hemispherical, the bracts numerous, acute, the inner ones fully 3 lines long, the somewhat shorter outer ones passing into the bracts on the peduncles. Ray-florets white faintly tinged with violet, about 30 in number or rather less, disk-florets longer than the involucre, abruptly narrowed at about the middle. Style-appendages narrow. Achenes densely silky hairy, the pappus-bristles of nearly equal length.

This interesting new species belongs to the Section Merismotricha of Archer's classification of the genus, and stands next to *O. adenophora* F.v.M., from which it is easily distinguished by the longer leaves, the herbaceous habit, and the absence of all viscidity. The collector asserts that it is an annual; and, if this be correct, it forms a rare exception to the usual habit of Australian species of the genus. It was found in masses in a clearing in virgin forest, at a considerable distance from all settlements, so that the supposition that it is a naturalised plant is very remote.

In honour of Miss Margaret Flockton, Botanical Artist, Botanic Gardens, Sydney, whose meritorious drawings of Australian plants are well known.

RUTIDOSIS LEIOLEPIS F.v.M. New for New South Wales.

Bibbenluke near Bombala (Miss E. Edwards; December, 1908).

The type-specimen was collected on the Snowy River, in Victoria. Bibbenluke is on an eastern tributary of the Snowy River in New South Wales, so it seems that the first recorded New South Wales specimen has been collected not far from the type-locality, though in an adjacent State.

ERECHTITES VALERIANÆFOLIA DC.

An introduced weed, new for New South Wales. This plant was reported in 1906, by Mr. F. M. Bailey, as overrunning certain Queensland scrubs; and we now report it also from New South

Wales. Mr. J. L. Boorman collected it in March, 1909, in a clearing in virgin forest at Dorrigo. It is a strong-growing plant, attaining 5 feet in height, and is distinguished from all Australian species of *Erechtites* by the colour of the pappus, which is purple at the top, paling down to white at the base.

The species is recorded in the "Index Kewensis" from Brazil only, but its range extends to North America. We have a specimen in the Herbarium collected, in 1899, by Prof. C. G. Pringle, in Mexico.

Ageratum conyzoides L. New for New South Wales.

Murwillumbah (R. C. Ewing; July, 1908).

It is not in Mueller's Census as a New South Wales plant, but one of us reported it in the Agricultural Gazette of New South Wales, in the year 1895, as a troublesome weed on the Northern Rivers.

Aster subulatus Michx.

Common in New South Wales.

Prof. A. J. Ewart writes (Proc. Roy. Soc. Vict. xix. 34, 1906) that this weed, which is common in New South Wales, appears to be spreading now in Victoria, and has been sent to Kew for determination, where it was determined as *Aster dumosus* L.(syn. *Tripolium conspicuum* Lindl., *Aster imbricatus* Walp., *A. arenaroides* Eaton). We had previously sent the same specimen to Mr. H. L. Fernald, of the Gray Herbarium of the Harvard University, U.S.A., who is a well-known authority on North American plants; and he determined the plant as *Aster subulatus* Michx., a species distinct from *A. dumosus* L. In comparing the New South Wales specimens with *Aster subulatus* and *A. dumosus* in this Herbarium, we found that our specimens agree exactly with the three or four specimens labelled *Aster subulatus*, and received from different sources and different localities; so that we must assume that Mr. Fernald's determination is the correct one.

FICOIDEÆ.

MACARTHURIA NEO-CAMBRICA, F.v.M.

Tomago, Hunter River (J. H. Maiden; May, 1908). The most southern locality recorded.

Bentham gives only one locality, Tweed River; and in the Herbarium we have it from only two localities, Byron Bay and Richmond River.

LAURACEÆ.

CASSYTHA FILIFORMIS L. New for New South Wales.

Coff's Harbour (J. L. Boorman; May, 1909).

The species has a wide range over the maritime districts in tropical Asia, Africa, and America; but has been, in Australia, previously only recorded from Queensland. It is evidently very closely allied to the common New South Wales *C. paniculata* R.Br., from which it can hardly be distinguished without fruits; but the fruits of the Coff's Harbour specimens are quite smooth, while the fruits of *C. paniculata* are distinguished by six raised longitudinal ribs.

LABIATÆ.

PRUNELLA VULGARIS L. var. LACINIATA Benth.(*P. laciniata* L.).

Mittagong (Henry Deane; November, 1900); Wingello (J. L. Boorman; December, 1900); Bowral (Wm. Greenwood; March, 1909).

Red and white flowering specimens of *Prunella*, received recently from Mr. Greenwood, drew our attention to this unrecorded variety, distinguished from the typical *P. vulgaris* by the white flowers and laciniate leaves. Var. *laciniata* seems not to be uncommon in New South Wales, but it has never been recorded, as far as we know. Opinions differ as to whether it is a variety of the common cosmopolitan *P. vulgaris*, or a distinct species. In the "Index Kewensis" it is regarded as distinct from *P. vulgaris*, while Bentham reduces it to a variety of *P. vulgaris* in De Candolle's Prodromus (Vol.xii., p.411); the fact that both are now recorded for Australia speaks in favour of Bentham's view.

ORCHIDEÆ.

Prasophyllum fimbriatum R.Br., var.?

Charley's Forest near Braidwood, about 8 miles from the Currockbilly Mountain, at about 3000 feet altitude, growing chiefly amongst the prostrate *Grevillea Renwickiana* F.v.M.(J. L. Boorman; March, 1909).

Stems slender, generally between 1 and 2 dm. high, the leaf reduced to a sheathing bract. Flowers few to 8 in the spike, about 2 or 3 cm. long, of dark claret-colour in general impression. Lateral sepals united at the slightly gibbous base, linear but narrowed towards the top and spreading with an undulate twist, 5 or 6 mm. long and about $1\frac{1}{2}$ mm. broad, acuminate and with a short abrupt point, purplish-brown, darker outside than inside, glabrous; dorsal sepal nearly the same length, acutely acuminate, light-coloured and striate, scantily fringed with purplish-brown hairs on the sides. Petals much narrower and shorter than the dorsal sepal and somewhat darker, acutely acuminate. Labellum contracted into a claw at the base, articulate and movable, gibbous at the base, linear-oblong, about as long as the lateral sepals, smooth at the surface and with two raised lines in the upper part, the edges densely fringed with long purplish-brown hairs. Lateral appendages of the column as long as the column, 2-toothed at the top, the inner tooth brown, the other yellow. Anther with a long point.

We drew up the above description from fresh specimens under the impression that we were describing a new species, *but we found out later that* we cannot point out any essential difference from Bentham's description of *P. fimbriatum*. Anyone who compares Mr. Fitzgerald's coloured plate of *P. fimbriatum* with the flower painted by Miss Flockton from our specimens, will at once see that the two plants cannot be identical. Apart from the striking difference in the colour, the two plants differ not inconsiderably in the shape of the labellum, petals, and appendages of the column. Robert Brown's original description applies equally well to both. To decide with certainty the question whether

Mr. Fitzgerald's specimen or our own is the nearer to R. Brown's type, access to the type-specimen is necessary, and this is beyond our reach.

GRAMINEÆ.

DICHELACHNE BRACHYATHERA Stapf, n.sp., Kew Bulletin, 1906, p. 203.

Swamp at head of Waterfall Gully, Mt. Wilson [Jesse Gregson (Gryson, in error, *loc. cit.*); March, 1906]. (Sent by us to Kew for examination).

This new species of *Dichelachne* is allied to *D. sciurea* Hook.f., but is distinguished from it by the smaller spikelets, the more unequal glumes, the much shorter awns, and the shorter anthers.

POA COMPRESSA L.

In these Proceedings, xxxiii., 1908, we recorded the above grass as new for Australia. Prof. Ewart has since drawn our attention to the fact that he has recorded this species as a naturalised alien for Victoria. It seems probable that, in this State also, the grass can be regarded only as an alien and not as truly indigenous.

FILICES.

GLEICHENIA FLAGELLARIS Spreng. New for New South Wales.

Cooranbong district, about 80 miles north of Sydney (J. W. Browne; March, 1909); Monga or Sugar-loaf Mountain, Braidwood (J. L. Boorman; March, 1909).

This Malayan fern was previously known in Australia only from a barren specimen collected on the top of the Macpherson Range, and published by Mr. F. M. Bailey some twenty years ago. It is common in the district from which we obtained the specimens, and it is sure to be found, in the future, in other Australian localities, but so far it seems to have escaped the attention of collectors.

Its systematic position is with *G. flabellata*, *i.e.*, the group with all the branchings leafy, but it is easily distinguished from it. In *G. flabellata* the angles in the forks of the branches are acute, and the pinnules are half upright; in *G. flagellaris* the angles in the forks are often nearly or quite a right angle, and the pinnules spread horizontally. The habit of *G. flagellaris* is very much that of *G. linearis* Clarke (*G. dichotoma* Hook.), but the latter is sharply distinguished from all other Gleichenias by the branches being leafless below the fork.

The nomenclature of this fern presents some difficulties, but we have neither the herbarium-material nor the library at our disposal to be able to settle the difficulty. *Gleichenia flagellaris* Spr., and *G. lævigata* Hook., are united in Hooker's "Synopsis Filicum," and kept distinct in C. Christensen's "Index Filicum." In van Rosenburgh's quite recently published "Handbook of the Malayan Ferns" the author adopts Hooker's name *G. lævigata*, and adds (?) *G. flagellaris* Spr., as a doubtful synonym. In a footnote he explains that *G. flagellaris* Spr., which has the undersurface very glaucous, is probably another species very near our plant, but not Malayan. It seems that the typical *G. flagellaris* is a native of Mauritius, and the Malayan form is *G. lævigata*, united later with *G. flagellaris*; if this inference is correct, the fern in question should be called *G. lævigata* Hook., if *G. flagellaris* is regarded as a distinct species, but the latter name has priority if they are united.

Angiopteris evecta Hoffm.

Burringbar, Tweed River district (B. Harrison; May, 1909).

No specific New South Wales locality for this common tropical fern has been previously recorded, so far as we know. Mueller, in his Second Census of Australian Plants, gives "N.S.W., Q." as its habitat; and, as it is not a native of either Norfolk Island or Lord Howe Island (included by Mueller in his "N.S.W." records), we must infer that he knew of a specific locality in New South Wales, but we cannot find any reference to this locality in his publications, and Prof. Ewart informs us that there are no New South Wales specimens of *Angiopteris evecta* in the National Herbarium, Melbourne.

The fern is evidently very rare in New South Wales. Mr. Harrison writes "I know of only one specimen in the Tweed district." The most southern Queensland locality recorded by Mr. Bailey is: gullies of the Blackall Range" in 26° 45 S.L., over 100 miles north of the border of New South Wales.

OLEANDRA NERIIFORMIS Cav. New for Australia.

Herberton, North Queensland (R. F. Waller, 1908).

The genus *Oleandra* has not previously been recorded for Australia. *O. neriiformis* is a very variable species, with an extensive range over Malaya, the Pacific Islands, and Tropical Asia. The leaves of the Queensland specimens attain a length of 60 cm.; the stipe is 6-7 cm. long, and the articulation is less than 1 cm. from the rhizome.

MARSILIACEÆ.

MARSILEA ANGUSTIFOLIA R.Br.

Coolabah (J. H. Maiden and J. L. Boorman; December, 1908), forming a dense turfy mass along the sloping (at present) unsubmerged part of the dam.

A new locality for a plant rare in New South Wales.

EXPLANATION OF PLATES XXXI.-XXXII.

Plate xxxi.

Halorrhagis Lucasi, n.sp.

Fig. A.—Flowering twig; nat. size.
Fig. B.—Bud.
Fig. C.—Flower.
Fig. D.—Flower, opened out.
Fig. E.—Portion of flower.
Fig. F.—Anther.
Figs. G-H.—Young fruits.
Fig. K.—Vertical section of young fruit, showing pendulous ovules.
Fig. L.—Transverse section of ovary.
Fig. M.—Portion of leaf.

Plate xxxii.

Baeckea denticulata, n.sp.

Fig. A.—Flowering twig.

Fig. B.—Opening flower.

Fig. C.—Flower, opened out, two petals removed.

Fig. D.—Calyx, showing the pentagonal ring where the stamens have fallen off.

Fig. E.—Transverse section of ovary.

Fig. F.—Vertical section of ovary; one carpel removed.

Fig. G.—Anthers, *a*, unopened; *b*, open; *c*, back view.

Fig. H.—Leaf enlarged.

STUDIES IN THE LIFE-HISTORIES OF AUSTRALIAN ODONATA.

Part ii. Life-History of *Diphlebia lestoides* Selys.

By R. J. Tillyard, M.A., F.E.S.

(Plate xxxiii.).

The beautiful dragonfly which is the subject of this paper, is the only representative of the family *Calopterygidæ* found in the temperate parts of Australia. In tropical Queensland a closely allied species, *D. euphaeoïdes* Tillyard, is found. These two species are the only known members of a peculiar and isolated genus, whose nearest allies must be sought for amongst the numerous Malayan representatives of the family.

Comparatively, very little appears to be known of the early stages of the *Calopterygidæ*. The great majority of the species are found only in the Tropics, and there seems to be nobody available who can spare the large amount of time and trouble required to study them in their native haunts. The life-histories of various species of *Calopteryx* and *Hetærina*, however, which inhabit Europe and North America, have been thoroughly worked out, and at least one remarkable nymph of a tropical genus (*Euphæa*) appears to have been studied. The latter is, I believe, unique, amongst Odonate nymphs, in possessing paired gill-filaments along the sides of the abdomen, similar structures being commonly found in the nymphs of *Ephemeridæ*. It was, therefore, apparent that much new and interesting information might be expected from the discovery of the nymph of *Diphlebia*. Whether it would shew similarity of form or structure to *Calopteryx*, or whether it might not even possess some remarkable structure peculiar to itself, as in the case of *Euphæa*, were questions on which I was eager to throw some light; so that it was with more than usual keenness and pleasure that I set about finding an answer to them.

Curiously enough, my first experience with a Diphlebia was the discovery of a new species, *D. euphæoïdes*, at Kuranda in North Queensland, in December, 1904. It was not until a year afterwards, when I visited the Mount Kosciusko district, N.S.W., that I came across the more widely distributed *D. lestoïdes*. On the Snowy River it was by no means uncommon, and was often a conspicuously beautiful object, as it rested, with expanded wings and brilliant blue body, on some rock in midstream, or on a twig of some overhanging bush. I was, however, quite unable to find out much about its habits. The males were rather shy, and difficult to capture; while the females were very seldom seen. Occasionally a pair were seen flying together over the water, but they were always attacked sooner or later by extra males, who generally succeeded in separating them or driving them off the river into the bush. Once or twice I came upon a pair at rest on a branch of a tree or bush, some distance from the water. We may reasonably conclude that the fertilisation of the ova is, therefore, generally accomplished away from the water, in some secluded spot of this kind. The next point to be observed was whether the male returned with the female to the river, and accompanied her during oviposition. Here I was completely at fault, for I never once saw a female ovipositing, although I was continually watching for them.

In pairing, the male uses his forcipate superior appendages to clasp the female round the prothorax, exactly as in the genus *Lestes*; the short inferior appendages press upon the occiput of the female.

I next saw this insect on the Goulburn River at Alexandra, Victoria, in December, 1906, but it was so extremely rare that I was unable to make any observations on it. In October, 1907, I was delighted to find it much nearer home, on the Woronora River, about twenty miles south of Sydney. Here I tried dredging and sweeping the water-weed with a net, but I failed to get any larvæ that could possibly be referred to this species. Nor was I able to discover any females in the act of ovipositing.

During September and October, 1908, I again visited the Woronora River, mainly with the idea of discovering something about *Diphlebia.* This year I failed to find it in its original locality, and was compelled to search out new haunts for it. On September 26th, I abandoned the main river, and tried the Heathcote Creek, a tributary, more accessible by rail, and not so rough for exploration. Some distance up this creek, the water comes down over a series of rocky ledges, forming small cascades and rapids. I was now using waders, and worked up the stream, dredging with the net under banks and along sandy bottoms, or in fact anywhere where larvæ might be found. While working under the roots of some "coral-fern" overhanging the creek, I obtained a most peculiar cast-skin of an Odonate nymph. It had been soaked in the water until it was soft and flabby, the only portions remaining at all intact being the head, and an enormous flat labium. My first impression was that it was the semifinal cast of some rare *Æschnid*, possibly *Telephlebia godeffroyi* Selys. However, the labium was of a peculiar type; the second joint of the antennæ was very long, and the anal opening of the abdomen very large and ragged, suggesting the possibility of some peculiar appendages. I had hopes that I was at last on the track of *Diphlebia*, and redoubled my efforts.

I again visited the same locality on October 3rd, but after dredging carefully all day, I met with no success. I now began to suspect that the larva might be an active creature inhabiting the bare submerged rocks, and that no amount of dredging would ever capture it.

The next Saturday, October 10th, I changed my tactics, and worked up the stream without using the net, peering carefully into the bright clear water, examining minutely the sides of the rocks, and the shady nooks under overgrown banks. Still no success ! I sat down by the side of the stream to think it over, and was gazing abstractedly at a small clear runnel of water between two ledges of rock, when I suddenly came on the solution of the problem. There, on the broad green blades of a large water-reed, at a depth of a foot below the surface of the running water, were two females of Diphlebia ovipositing. I watched the operation with the greatest interest. Kneeling down on the rock, and shading the reed from the sun with my hat, I was able to place my eye just above the insects. They appeared to be encased, as it were, in silver from head to tip, owing to the fact that they were completely surrounded with air. The operation of ovipositing was conducted fairly quickly, by raising the abdomen slightly, puncturing the reed with the ovipositor, and inserting an egg. Each female made two or three punctures nearly in a horizontal line; then, by contracting her abdomen, three or four more about one-quarter of an inch above the others, and so on; every now and then climbing higher up the reed. One female was working on one side of the reed, the other on the other; and one was about four inches above the other. I watched them for about five minutes, during which time they must have laid close on fifty eggs apiece. Then the upper female began to ascend the reed rapidly, and crawled out on to my hand, *perfectly dry*, the second one following half-a-minute later. I captured both and papered them. At the time I was astounded at the apparently large amount of air held by them under water, but a little reflection made me see how easily they contrived to do so. The long thin wings, folded back along the abdomen, reach nearly to its tip, and were so placed as to enclose between them a large amount of air, which passed also beneath the abdomen, forming a perfect sheath or covering. Between the head and prothorax also, on each side, a large bubble of air was held, and this extended backwards along the thorax and forwards under the eyes, so that practically the whole insect was protected from the water. Probably also the amount of air was sufficient to make the specific gravity of the insect about the same as that of water, and hence to enable it to move up and down in the swiftly running water with great facility.

I carefully gathered the reed, and carried it home in water for examination. I found each leaf full of punctures for a distance of about four to six inches. Each puncture contained beneath it a transparent egg about 1 mm. long. I cut off one portion of the reed, about three inches, which was full of eggs, and placed it in clear water in a flat Petri dish; all the rest were put into a large jar of water.

The ovum is elongate-oval in shape, with one end rounded and the other pointed; the portion towards the pointed end is the thicker. *In situ*, the rounded end is furthest from the puncture, the point of the egg just resting in the opening. The ova do not darken materially during the first fortnight. At the end of three weeks they are dull yellowish. On November 15th, five weeks after they were laid, I examined the eggs in the Petri dish, and found them a pale rich brown in colour, with two minute black spots indicating the position of the eyes of the embryo. (See Plate xxxiii., fig. 3; *a*, ovum during first fortnight; *b*, same, five weeks old). Meanwhile the reed in the large jar had decomposed, and the ova were affected with fungus, so that I was obliged to throw them away.

On November 20th, forty-one days after the ova were laid, the first larva hatched in the dish. During the next few days more than a dozen hatched out; the rest apparently were either sterile or affected with some parasite which I was unable to determine; at any rate they failed to hatch out.

The young larva sits on the sharp edge of the reed. It is perfectly transparent, except for the two tiny black eyes. Length 1·5 mm over all; caudal gills long and slender, hairy; legs rather long. The creature is very active, and shows vigorous fight when poked at with a pin.

When about four days old the larva is 2 mm. long over all, and is brownish, slightly mottled, and considerably stouter in build than when first hatched. The colour darkens gradually until the first ecdysis takes place, after which it becomes pale and transparent again.

When the larvæ were about a month old, I removed one to a watch-glass in order to sketch it. It was most active, and I was unable to use the camera lucida. However, I made a careful pen-and-ink sketch of it, which is now reproduced in Plate xxxiii., fig.4. Length over all 3 mm, colour pale straw; head round, hairy in front, antennæ with seven joints approximately equal; all tibiæ with a few long hairs. Caudal gills distinctly triquetral, strong, transparent, very hairy.

I then introduced some animalcula into the watch-glass, and was fortunate in seeing the little larva feed. On the approach of a rotifer, the larva sat up in a pugnacious attitude, suddenly darted forward, seized the rotifer in its labium with a stroke as quick as lightning, and then shook and worried it from side to side with tremendous energy. The labium is very large for the size of the insect, and exceedingly powerful. After worrying its prey for a full minute or more, the larva retracted its labium, and appeared to hold the rotifer in it quite easily when closed, while it made its meal. I had further opportunities of watching these small larvæ feed when more fully grown, and in every case they seized their food in a most active manner, using their powerful legs to spring forward and asisst the labium to reach its prey.

On December 19th, 1908, prior to leaving Sydney for a few weeks, I emptied the Petri dish, containing about a dozen small larvæ, into a large cylindrical jar in which water-weed was growing, and having a clean shell-grit bottom. I then introduced a supply of infusoria sufficient to last until my return, and arranged to have the water kept up to a certain level, evaporation being very rapid in the hot summer months.

On my return, on January 27th, 1909, I immediately examined the jar. Apparently there was only one larva living, a robust fellow, skulking at the base of a twig, and so shy that, whenever I approached, he moved rapidly round to the other side of the twig, like an iguana. Length about 6 mm. over all; colour pale dirty white, touched with brown. It is difficult to say whether another ecdysis had taken place or not. About February 1st, the larva forsook its position on the twig, and hid itself under a large shell, where it remained for a week. On February 9th, I noticed a fine floating skin, showing that an ecdysis had taken place. Meanwhile the larva had returned to its position at the base of the twig, and appeared to be very alert and feeding well.

Towards the end of March, I carefully examined the larva and made a sketch of it. Length over all 8·5 mm., of which the caudal gills account for about 3 mm.; colour pale straw. *Head* rather square in front, with labium projecting slightly beyond it like a flat shelf. *Antennæ* seven-jointed, with the second joint elongated, the others shorter and about equal in length, except the top joint which is very thin and short; basal joint thickened; bases of joints 3-6 white, rest dark; second joint with small hairs all along it; a small tuft of two or three hairs at distal end of joints 3-6 (see Plate xxxiii., fig.5). *Eyes* black, with stiff hairs just below them. *Prothorax* and *forelegs* very strong and well developed, smooth. *Meso-* and *metathorax* together not much larger than prothorax; middle and hind legs fairly long, smooth. *Abdomen* rather short, thick, segments all very short; segment 10 fairly wide. *Caudal gills* 3 mm.; the lateral ones thick at bases, strongly triquetral, the cross-section apparently a triangle with base nearly flat and slant sides *convex* rather than concave; median gill less triquetral, narrower at base, projecting in a vertical plane at an angle of nearly 60° above the other two, which diverge in a horizontal plane at about the same angle. Under a lens the two main tracheæ can be seen branching out from the base of each gill, but these become transparent and soon divide up into innumerable smaller tracheæ which are practically invisible. For the first half of their length the gills increase in width, the top edge being convex, especially in the median gill; they then narrow rapidly to a long thin point, the last two-fifths being very hairy.

Towards the middle of April the nymph forsook its perch on the twig and hid under a shell, preparatory to another ecdysis. Soon afterwards it returned to the twig for a short time, and appeared very restless. I judged from its dark colour that the ecdysis was not yet over. During the next few days it became very sluggish, but fortunately it took up a position between a white shell and the glass of the jar, where I could watch it easily. On April 3rd, I noticed several water-fleas clustering round it, and on examination I found that it was dead, having only partially succeeded in casting its old skin. The small water-fleas, too, had apparently partly destroyed its caudal gills, so that I was glad I had already made a sketch of them. Considering how very different both the food and the habitat of my artificially raised nymph were from those it would have had in a state of nature, it was scarcely to be expected that I could obtain a full-fed specimen. Possibly a diet of infusoria and small water-fleas may have been the cause, in the end, of its failure to undergo ecdysis; or living in stagnant water instead of a swift mountain stream may have been sufficient to prevent the full use of its strong muscular limbs, and so weakened it physically. I was fortunate, indeed, in keeping it so long alive and in being able to sketch the caudal gills and antennæ of the young larva.

To complete the life-history, it was necessary to find either the full-grown larvæ or the exuviæ. I doubt if it is possible ever to obtain the first, for I judge from my observations of the young larva that it probably lives in the crevices of the solid bed-rock of the stream, and is active enough to retreat rapidly away from any net or instrument used to snare it. Of the exuviæ I was fortunate enough in obtaining *four*, as the result of examining, for a whole day, rocks and boulders in the bed of the stream in the Rodriguez Pass, Blackheath, N.S.W., on November 7th, 1908. I found them clinging to the rock-surface, in company with a large number of ephemerid exuviæ of smaller size. The claws of the tarsi had such a firm hold of the rock that it was with the greatest difficulty that they could be detached without damage. I recognised these exuviæ at once as being similar to that found at Heathcote. Two of them also possessed shrivelled remains of caudal gills. An examination of antennæ and labium showed that they were the same species as the small larvæ bred from the Heathcote ova; in fact the latter, even in that early stage, showed a very close resemblance to the exuviæ in general form. As *Diphlebia lestoïdes* was the only zygopterous dragon-fly to be found along the Rodriguez Pass, where it is fairly common, I now felt quite certain that I had the exuviæ of that species, a full description of which I append.

Total length (excluding gills) 23·5 mm. *Head* large, 5·5 mm. wide, rather flat, slightly convex above; *eyes* not prominent, but well inset, the postocular lobes large, smooth, rounded; just under the eyes, in front, is a series of sharp curved spines, four in number, of which the front one is thick and strong; there is also a set of smaller spines near base of antennæ. *Antennæ* very long, 7 mm., smooth, thin, filiform, *second* joint very long. (Notice that the hairs on the antennæ of the young larva are absent in the exuviæ). *Ocelli* small, reniform, inconspicuous, placed in a triangle between the eyes. *Labium* enormous, measuring 6·2 mm. by 4·8 mm. when folded; perfectly flat underneath and projecting in front somewhat beyond the upper parts of the head, and backwards well past the procoxæ, so as to cover most of the underside of the prothorax; *mentum* rather shield-shaped, furnished with a set of small stiff spines on each side, and projecting slightly forward in front in a rounded curve with slight median indentation; no setæ present; *lateral lobes* strong, rather narrow, with several small spines on the outside along the basal portion; terminating in a sharp slender *movable hook* and in three smaller fixed spines or hooks; of these the middle one is the largest, and below its base is a much smaller one; the third lies behind and between the movable hook and the larger fixed hook (see Plate xxxiii., fig. 2). *Prothorax* well developed, rounded above; procoxæ set well forward under the head; forelegs exceedingly strong and large, femora broad, smooth, and flattened; tibiæ straight, smooth, and narrow; tarsi short, three-jointed, ending in two strong claws. *Meso-* and *metathorax* almost as wide as head; smooth, strongly built but not large; middle- and hind-legs also strongly built, with flattened femora. In the position of rest, the fore-legs are projected well forward and pressed close to the rock; the labium also presses close to the rock; the femora of the middle-legs lie almost flat, but those of the hind-legs are held with the broad flat sides nearly vertical; the whole position suggests that the insect lies concealed by clinging flat against the rock, and is ready to spring forward at its prey at any moment. Measurements of femora, tibiæ and tarsi of fore-, middle-, and hind-legs are—fore, 5, 5·5, 2·5 mm.; middle, 6, 6, 2·5 mm.; hind, 8, 6, 3·5 mm. *Wing-cases* narrow, about 7·5 mm. long, reaching to just beyond segment 3 of abdomen. *Abdomen* very short, 12 mm., first three segments wider and longer than the rest; rounded above, flat beneath; segments 5-9 of about equal length and width, segment 10 shorter but of same width. *Caudal gills* (shrivelled) 10 mm., blackish, the lateral ones showing thick triquetral bases.

[See Plate xxxiii., fig.1. N.B.—The caudal gills, as sketched in the Plate and enclosed in a dotted square, are reconstructed from the sketch made of the gills of the four-months old larva, and must not be taken as absolutely accurate.]

The colour of the larva is apparently a uniform dull dark brown all over.

Date of emergence.—The eggs are laid in November, and there is no doubt, judging from the progress of the larva in captivity, that they are full-fed in a year. The perfect insect, in the Sydney district, begins to emerge during the last week of September, and continues coming out till the end of October. In the colder districts of Kosciusko and Victoria, newly emerged individuals may be found late in January, by which time the insect has completely disappeared again in the Sydney district.

Hab.—Fast mountain-streams in New South Wales and Victoria.

The perfect insect has been described by de Selys, and again by René Martin* from specimens taken by Capt. Billinghurst at Alexandra, Vic. In my paper on "New Australian Species of the Family *Calopterygidæ*"† I have compared it with *D. euphæoïdes* and have corrected some errors of description due to the fading and changing of the brilliant colours in dried specimens. I have never, in the Sydney or Kosciusko districts, noticed the large range of variation in size and colour noticed by Martin.

* "Les Odonates du Continent Australien," Mem. Soc. Zool. de France, 1901, p.243.

† These Proceedings, 1907, p.398.

Note on oviposition.—The method of oviposition in the tissues of reeds under water is not the only way employed by the species. During a visit to Leura, on December 5th, 1908, I distinctly saw a female alight on the almost vertical face of a mossy rock, over which the stream was trickling, and insert her ovipositor at least a dozen times into the moss-tissues. It then flew off up stream and repeated the operation further on.

In his work on the life-histories of American *Zygoptera*, Prof. J. B. Needham gives, for classification-purposes, the following differences between *Calopterygid* and *Agrionid* nymphs:—

"*Basal* segment of antennæ *very large*, as long as the other six together, median lobe of labium *with a very deep cleft*; gills thick, the lateral ones triquetral...*Calopterygidæ*."

"Basal segments of antennæ *not* longer than succeeding segments; labium with a very shallow closed median cleft, or no cleft at all; gills thin, lamelliform...*Agrionidæ*."

This classification was adopted on the knowledge afforded by the study of the nymphs of *Calopteryx* and *Hetærina* only. It will be seen at once that the nymph of *Diphlebia* differs in important respects from those of these two genera.

Firstly, as regards the antennæ. In *Diphlebia*, it is the *second* joint which is greatly elongated, the basal joint being short and thick. The elongation of this joint, however, is not so great as that of the basal joint of *Calopteryx*. I am inclined to regard elongated antennæ in dragonfly nymphs as a primitive character. The reduction in length has been carried to a great extreme in the imagines, and one can see no reason at all, even in the nymphal stages, for the continuance of elongated antennæ. In all burrowing nymphs they have become very short, and in the *Gomphinæ* the number of joints is actually reduced to four. The possession of long antennæ may then merely mark out the more primitive families, but it will also mark isolated groups which may have been placed outside of these families for more important structural reasons. I shall show, in a later part of this paper, that the long basal joint is possessed by *at least one Agrionid* found commonly in parts of Australia. This suggests that it was a characteristic of the original *Zygopterid* stock before the differentiation of the *Agrionidæ* from the *Calopterygidæ* was fully established.

Secondly, as regards the labium. Unlike the labia of *Calopteryx* and *Hetærina*, that of *Diphlebia* is *not* deeply cleft medially; in fact it possesses a median lobe of the usual *Agrionid* form. Apart from this, the labium of *Diphlebia* is remarkable (*a*) for its great size; (*b*) for the broad shield-shaped mentum, recalling that of the *Æschnidæ*; (*c*) for its flatness, which also recalls that of the *Æschnidæ*. There is, however, a considerable resemblance in the form of the *lateral* lobes in *Diphlebia* and *Calopteryx*; each carrying, besides the movable hooks, *three* fixed hooks or teeth. *Hetærina* appears to possess *four* fixed teeth, but the dentition in this genus really consists of two parts, the upper one being itself tridentate. Both lateral and mental setæ appear to be present in *Hetærina* and *Calopteryx*, though in the latter genus they are nearly reduced to vanishing point. *No setæ* are present in *Diphlebia*.

Thirdly, as regards the caudal gills. Here the triquetral character is even more pronounced in *Diphlebia* than in *Calopteryx*; for even the median gill of *Diphlebia* is distinctly triquetral and not lamelliform, though this gill is distinctly flatter and more leaf-like than the lateral ones. It is a pity that a full-grown *Diphlebia* nymph with perfect gills cannot be obtained, for it must be understood that those sketched in the central figure of the plate are, at best, approximate only, being drawn, without actual measurements, from a sketch of a four-months-old larva. It will be seen that in the young larva the gills were hairy all over, but that, at four months, the hairs are restricted to the outer two-fifths. Hence it is quite possible that when the final nymphal stage is reached they may be completely hairless. I am unable to find hairs on the shrivelled remains of the gills attached to the exuviæ, but their condition is not such as to warrant the deduction that they may not have been there originally.

In these large triquetral gills we have clearly a form handed down from remote antiquity. If the presence of numerous branched tracheæ in these gills suggests anything at all, it must be that *originally* they were in some way organs of respiration. In the *Agrionidæ* we see them converted from their original use into practically an aid to locomotion only. It is certain that the loss of these gills, even in *Diphlebia*, does not affect the respiration of the insect in any way, for two of the four exuviæ I possess *have no gills left at all.* I noticed several of my young larvæ without caudal gills only a few days after birth, so that it is clear that they are easily broken off and lost. After an ecdysis they are again replaced, though usually somewhat smaller than a gill that has not been lost previously. The triquetral form suggests a modification of some original structure capable of receiving a large quantity of water for purposes of respiration. I doubt whether even the wide lateral gills of *Diphlebia*, fed by two large tracheæ, are of any use at present for auxiliary respiration. The form of structure has probably persisted long after its use has vanished. Be that as it may, the triquetral gill appears to be at present confined to the *Calopterygidæ* alone.

The larva of *Diphlebia* shows no signs of the paired abdominal gill-structures found in *Euphæa.* Such structures could scarcely be expected to persist in what, I think, must be regarded as a highly successful and specialised branch of the Calopterygid stock. In the imago, the reduction of cross-veins in the wings has been carried out to such an extent as almost to have reached the end achieved by the *Agrionidæ.* One feels that there is much to ponder over in the unerring insight which led de Selys to give the name *lestoïdes* to this peculiar insect. There is more than a superficial resemblance, especially if the comparison be made, not with *Lestes* but with *Argiolestes.* Though more than two antenodals still persist, only the first two are continuous into the subcostal region; so that the elimination of the other three or four is at least half-accomplished. In the larva itself we probably have the secret of the success of this type. Its whole form,—the enormous strength of the legs, the huge labium and in-set eyes—shows us at once that Nature has evolved a successful type capable of holding its own against all its enemies, and evolved it along a line entirely different from all other Australian *Zygoptera*, except perhaps *Argiolestes*. The larva is, in fact, an active predatory insect, and probably is quite able to defend itself against attacks by enemies larger than itself, using its labium as well to ward off attack as to capture its food, and its strong legs to enable it to retreat quickly backwards into a crevice if the necessity arises. I was much struck by the vigorous way in which the newly hatched larvæ shewed fight when attacked with a fine pin-point. They would back vigorously, darting out their labia with great rapidity, and finally, if pressed, dodge rapidly aside, all the time keeping ceaseless vigil. I have never been able to provoke any other Zygopterous larva to shew fight. In this respect, *Diphlebia* resembles some of the large *Æschnidæ*, whose larvæ, dwelling on submerged sticks and twigs, stalk their prey with great perseverance and watchfulness. Possibly this may suggest the reason for the convergence in the form of its labium to that of an Æschnid.

In conclusion, I regret that my attempt to raise this interesting larva has been only partially successful. Probably a closer approximation to natural conditions — running water, and animalcula obtained from its natural haunts—may be the road to final success.

EXPLANATION OF PLATE XXXIII.

Diphlebia lestoïdes.

Fig.1.—Exuviæ (×4). N.B. The caudal gills, enclosed in a dotted square, are supplied from a sketch of those of a larva four months old; those of the exuviæ are shrivelled.

Fig.2.—Labium.

Fig.3.—Ova, *a*, one week old; *b*, five weeks old.

Fig.4.—Larva one week old.

Fig.5.—Antennæ of four-months-old larva.

THE INFLUENCE OF THE DILUTION OF SERUM UPON THE PHAGOCYTIC INDEX.

By R. Greig-Smith, D.Sc., Macleay Bacteriologist to the Society.

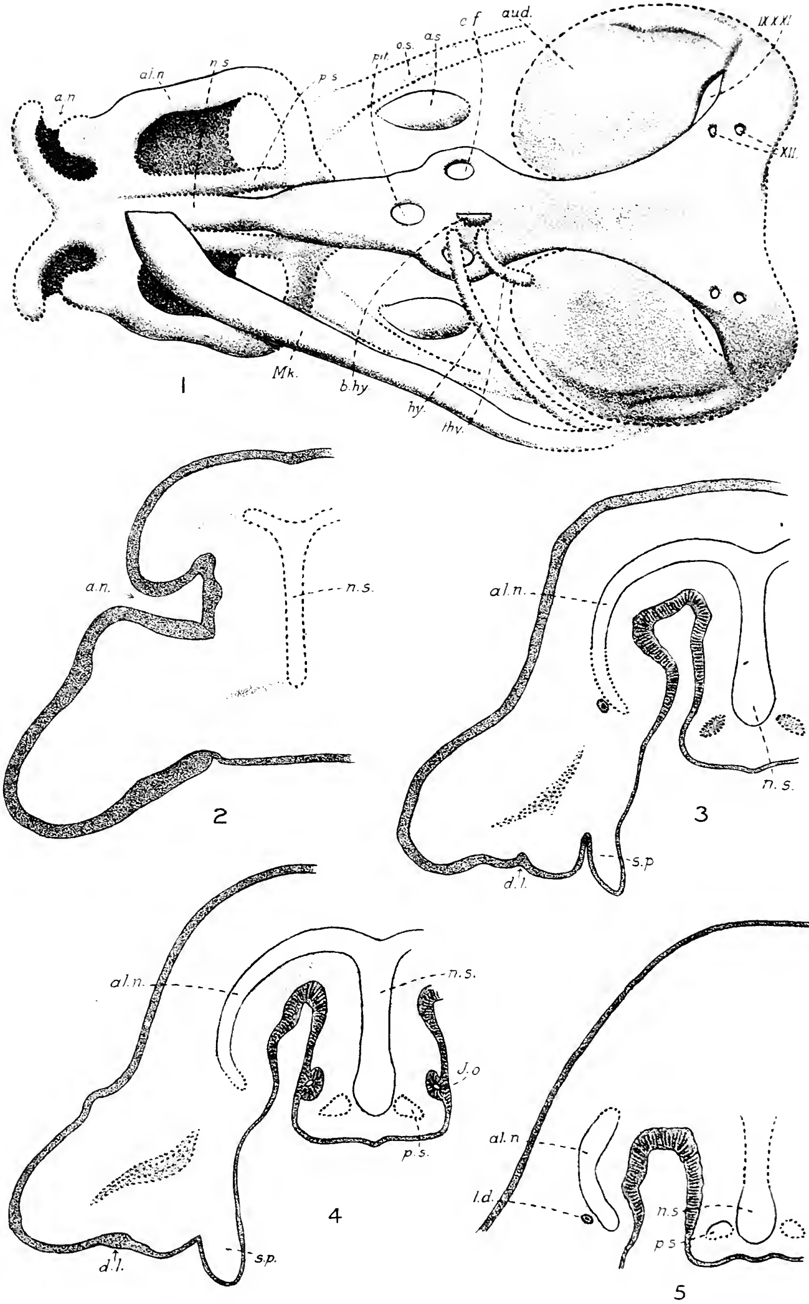
(With eight text-figs.)

When normal serum is progressively diluted with physiological salt solution, the opsonic activity is found to rise with the dilution to a certain point and then fall. This was noted by Wright and Douglas,* and was confirmed during my work.† Dean‡ showed later that the phenomenon was probably caused by two factors, one of which causes a sharp rise from infinity to a point at the quarter dilution when another factor comes into play and, retarding the rapid rise, causes a fall in the curve from the half dilution to the undiluted serum. In my own experiment this point agreed with the $\frac{1}{6}$ dilution, and, in Wright and Douglas's experiment, it was probably at the $\frac{1}{12}$. As Dean has taken the average of a greater number of experiments, his number is more trustworthy, although it must be remembered that he probably made his tests by the more modern method of using the serum and suspensions of corpuscles and bacteria in the ratio of 1:1:1, while both Wright and I used the older ratio of 3:3:1. The greater proportion of serum to saline might cause the differences between the points when the depressing action of the serum appears.

In endeavouring to account for the behaviour of the serum upon the dilution, much might be gained by remembering that opsonisation, while possibly not identical with, may still be closely related to agglutination. In a former paper I showed that they were probably identical; and recently Weil,‖ in a

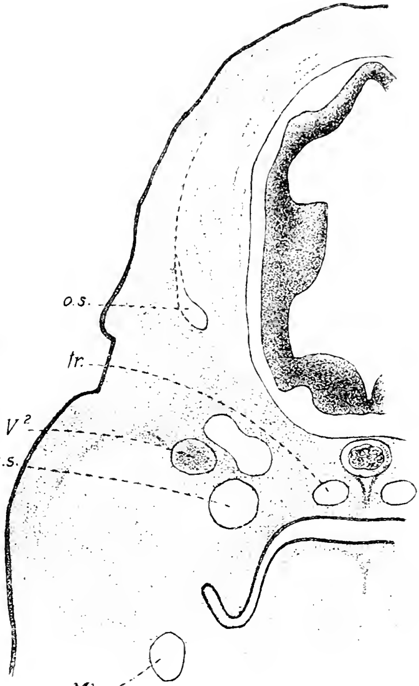
* Proc. Roy. Soc. 73, (1903), No.483, p.364.
† These Proceedings, 1905, p.563.
‡ Proc. Roy. Soc 79, (1907), No.B 533, p.401.
‖ Centrlb. für Bakt. Ref. 42 (1908), p.345.

[Printed off September 8th, 1909.]



R.B. del. H.J.A.B. lith.

TRICHOSURUS VULPECULA (10 mm.)



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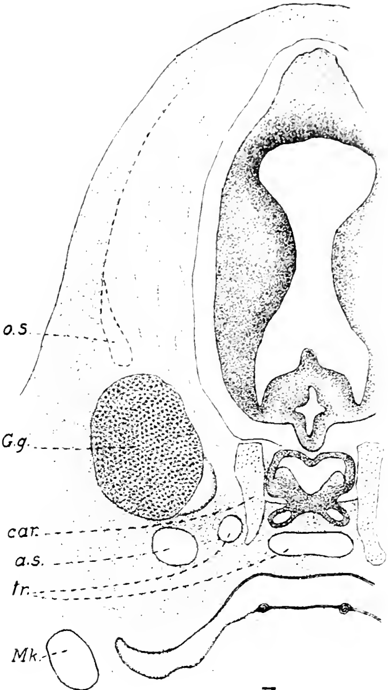

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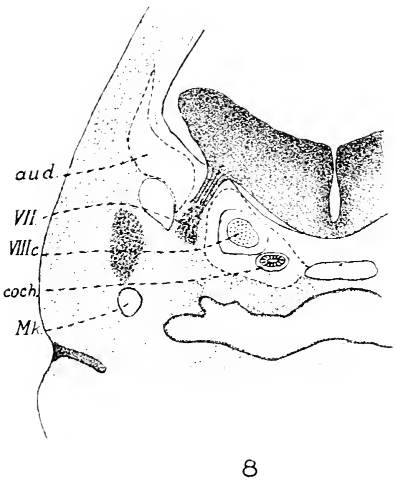

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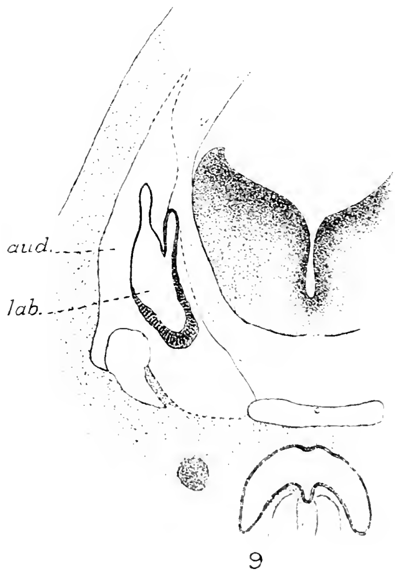

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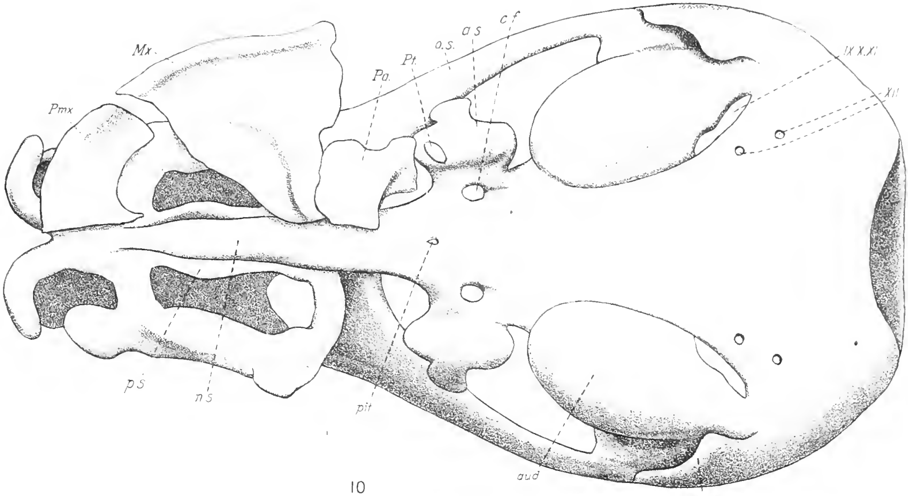
R.B. del.

TRICHOSURUS VULPECULA (10 mm.)



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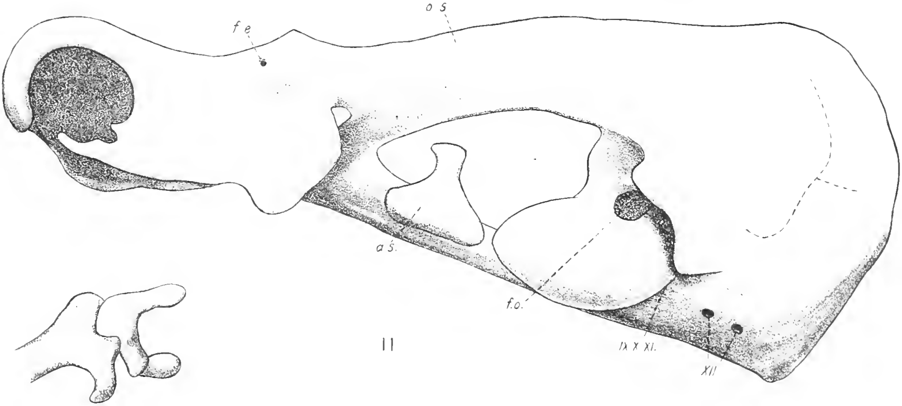

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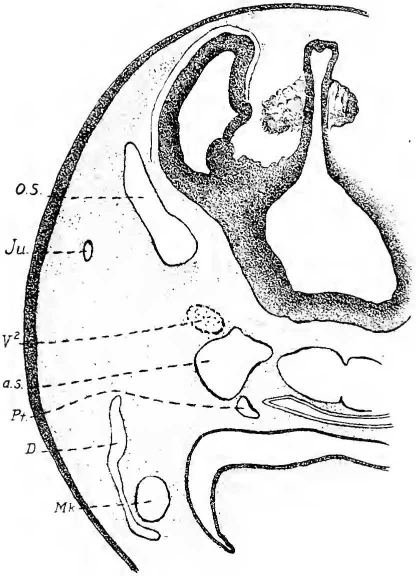
11a.

R.B. del. H.J.A.B. lith.

TRICHOSURUS VULPECULA (14 m.m.)

R.B. del.

TRICHOSURUS VULPECULA



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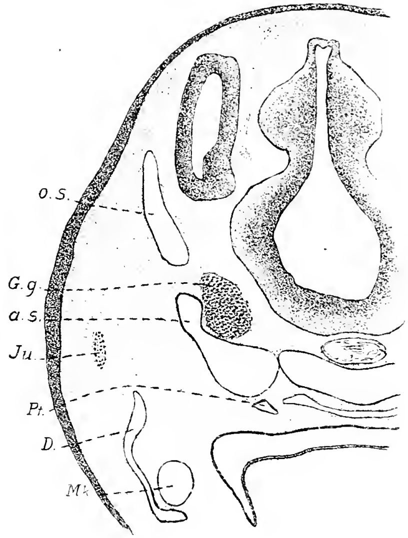

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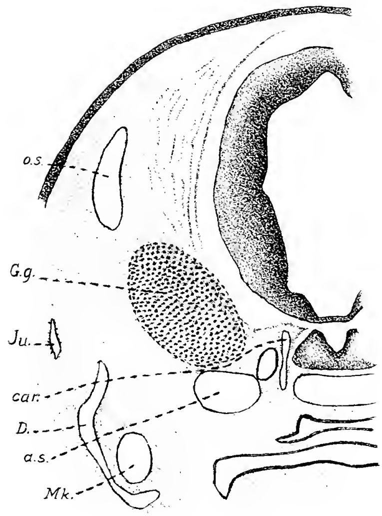

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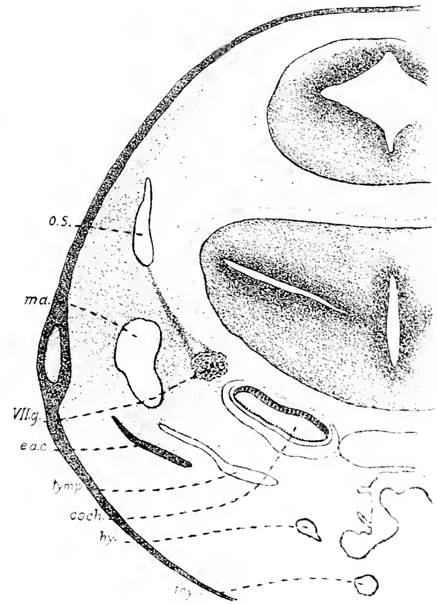

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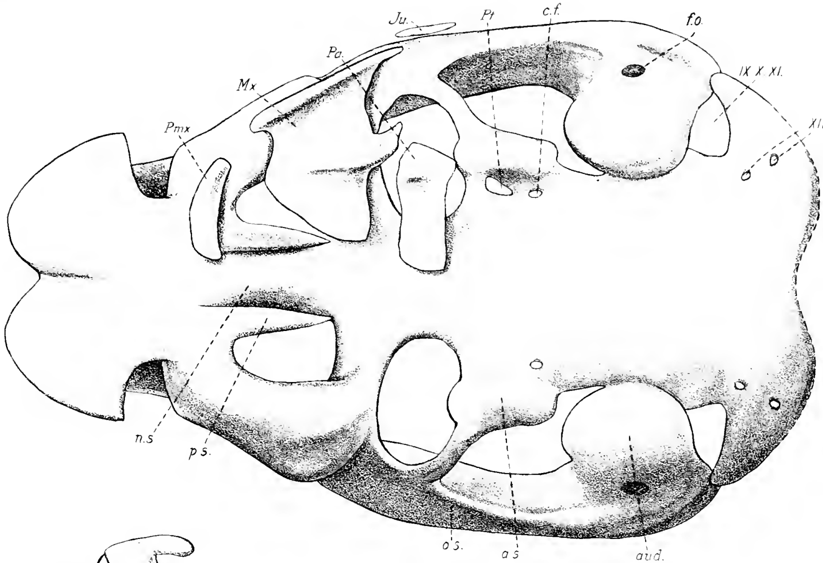
R.B. del. H.J.A.B. lith.

TRICHOSURUS VULPECULA (14 mm.)



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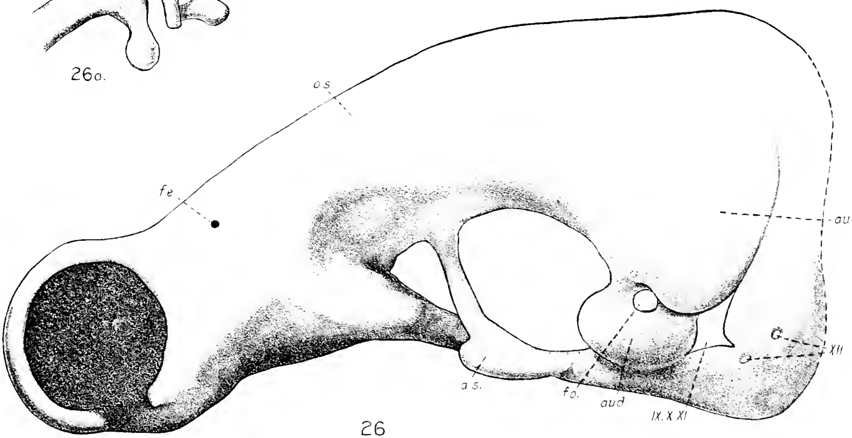
26a.



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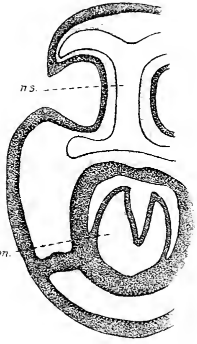
R.B. del.

DASYURUS VIVERRINUS (8 mm)

H.J.A.B. lith.



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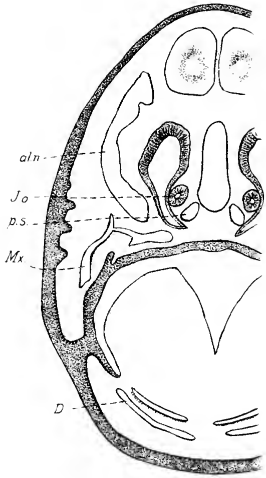

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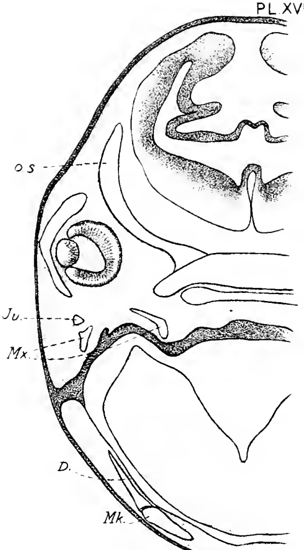

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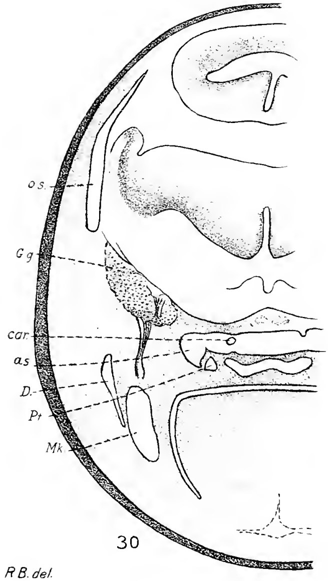

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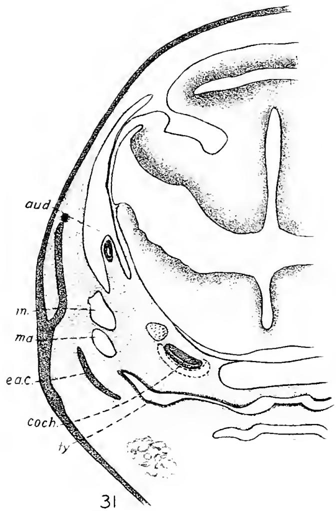

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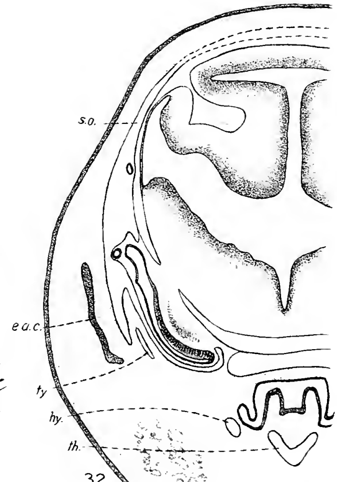

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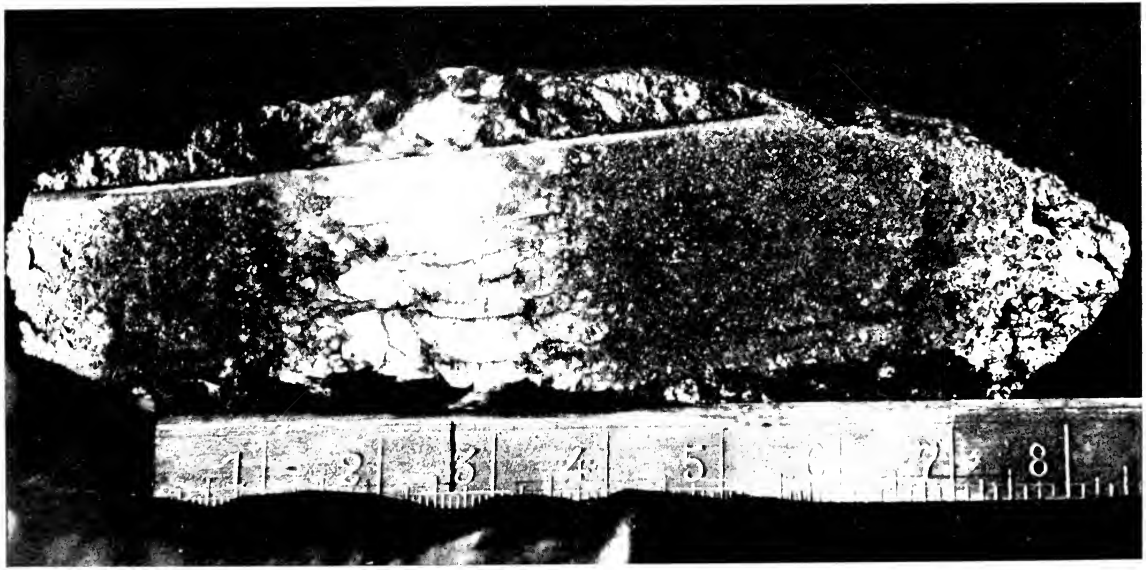
R.B. del.

DASYURUS VIVERRINUS (8 mm)

H.J.A.B. lith



SECTION ACROSS FISSURE-VEIN, SHOWING NORMAL GRANITE ON EACH SIDE, AND VEIN-MATERIAL BETWEEN.

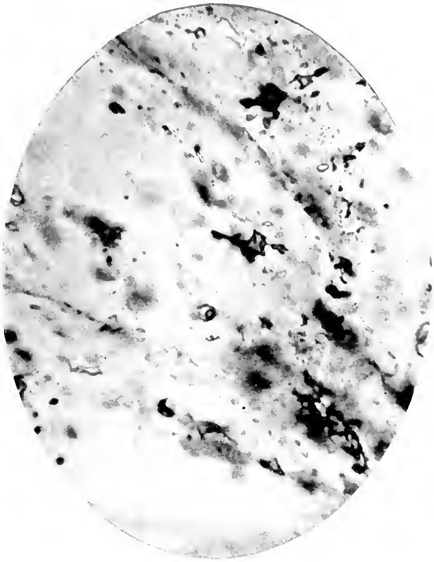


FIG. 1.

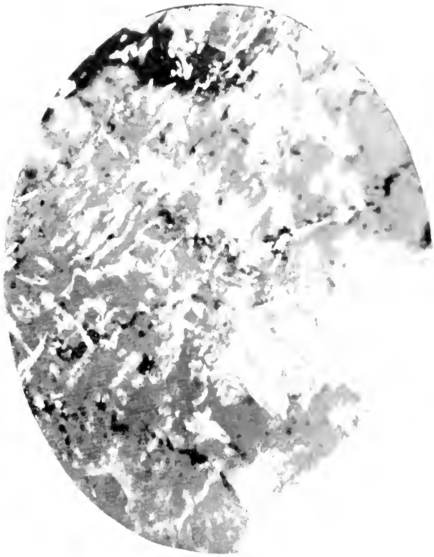


FIG. 2.

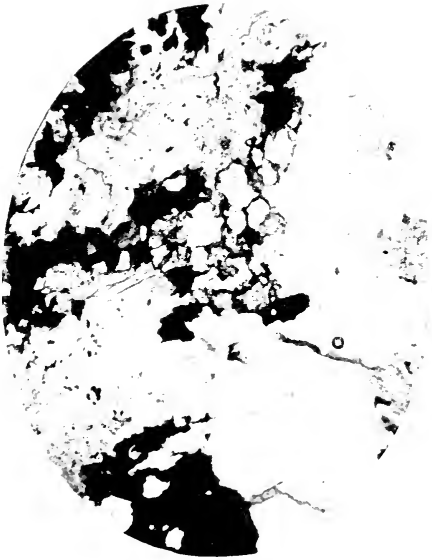


FIG. 3.

FIG. 4.

FIG. 1

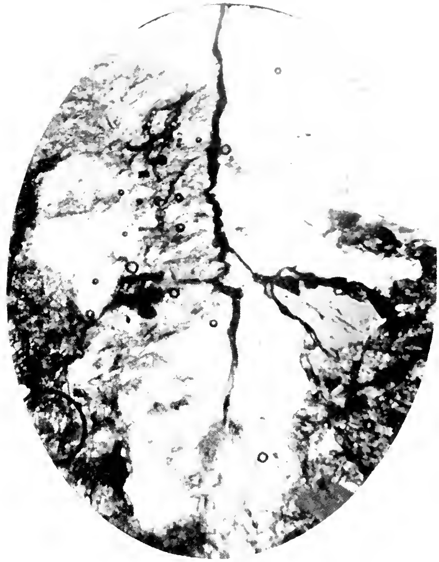


FIG. 2.

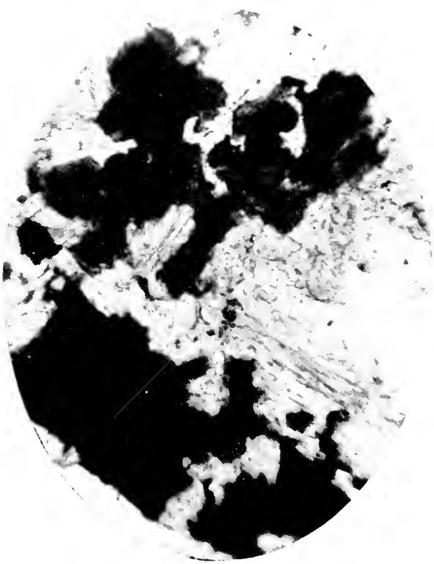


FIG. 3.

FIG. 4.

FIG. 1 GUYRA LAGOON, N.S.W., LOOKING TOWARDS THE EAST.

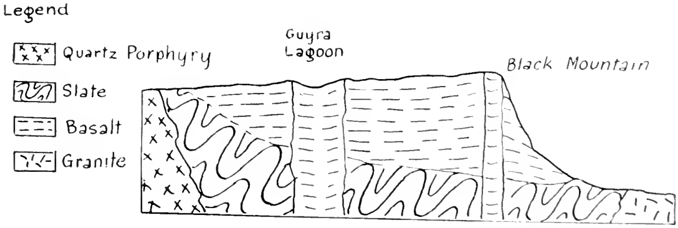
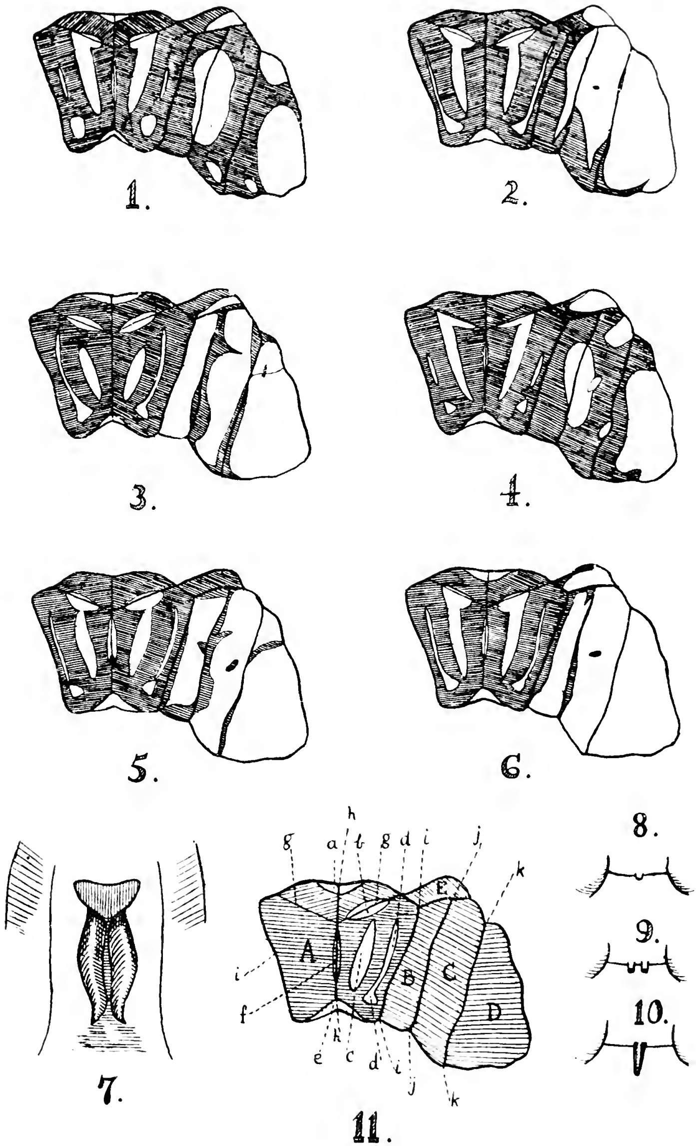
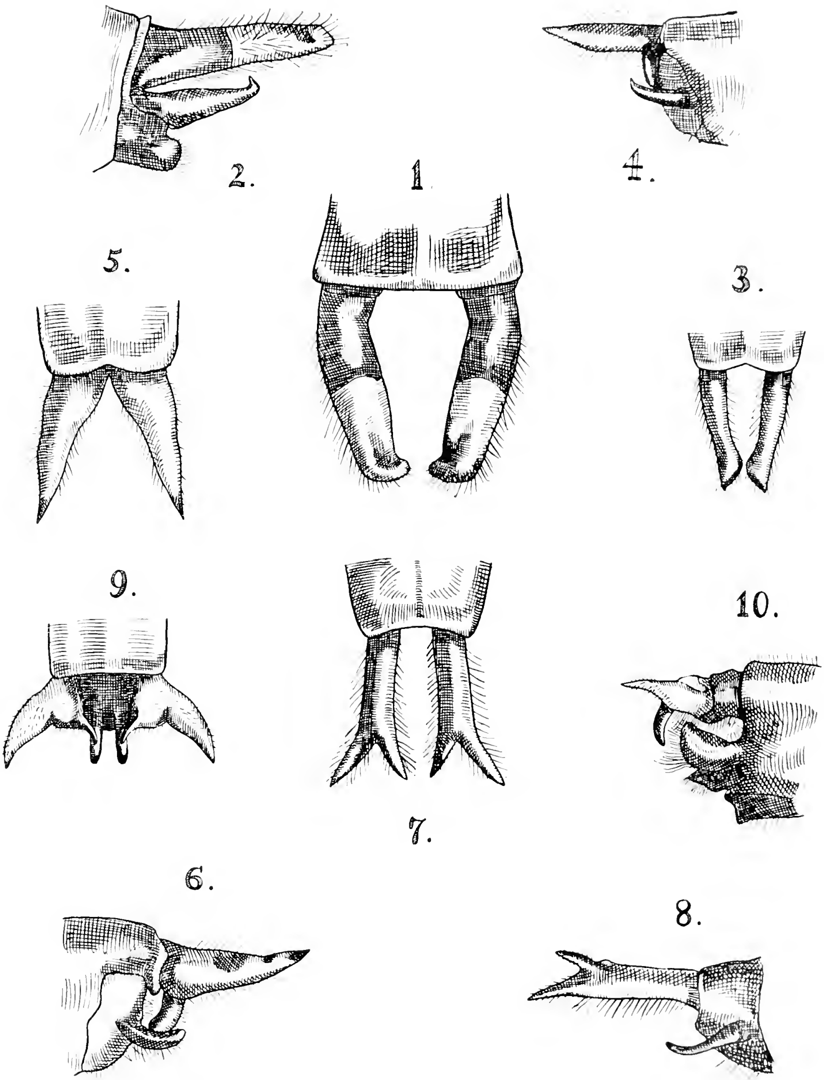


FIG. 2. DIAGRAMMATIC SECTION THROUGH GUYRA LAGOON FROM NORTH-WEST TO SOUTH-EAST.



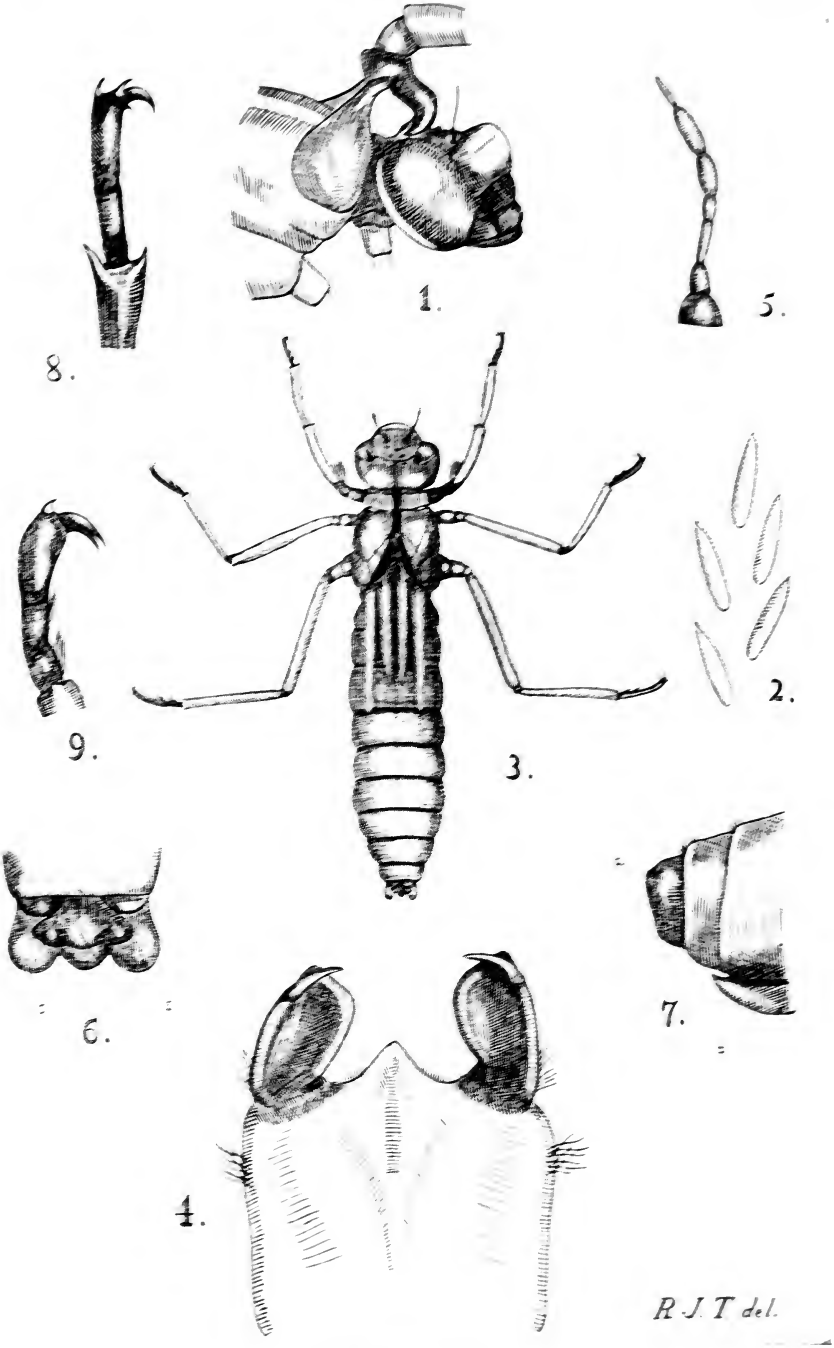
R. J. T. del.

THORACIC COLOUR-SCHEMES &c. OF AUSTRALIAN GOMPHINÆ

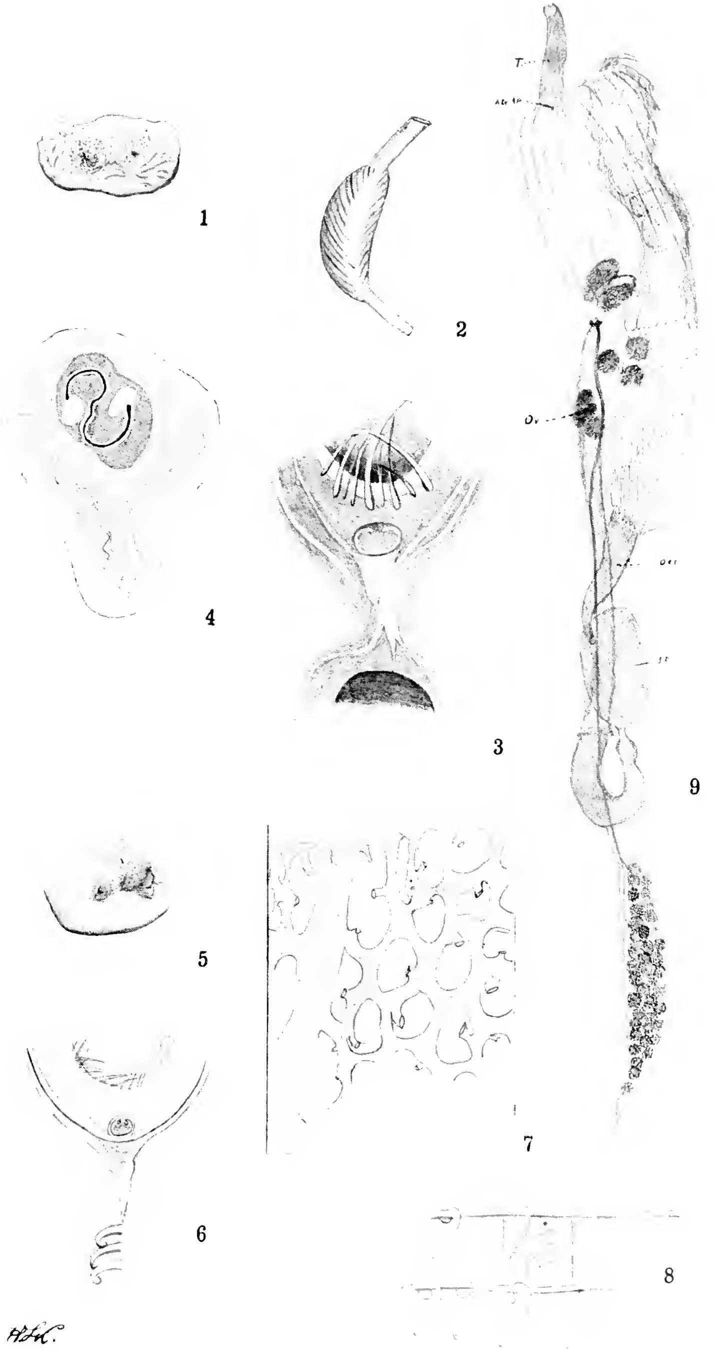


R. J. T. del.

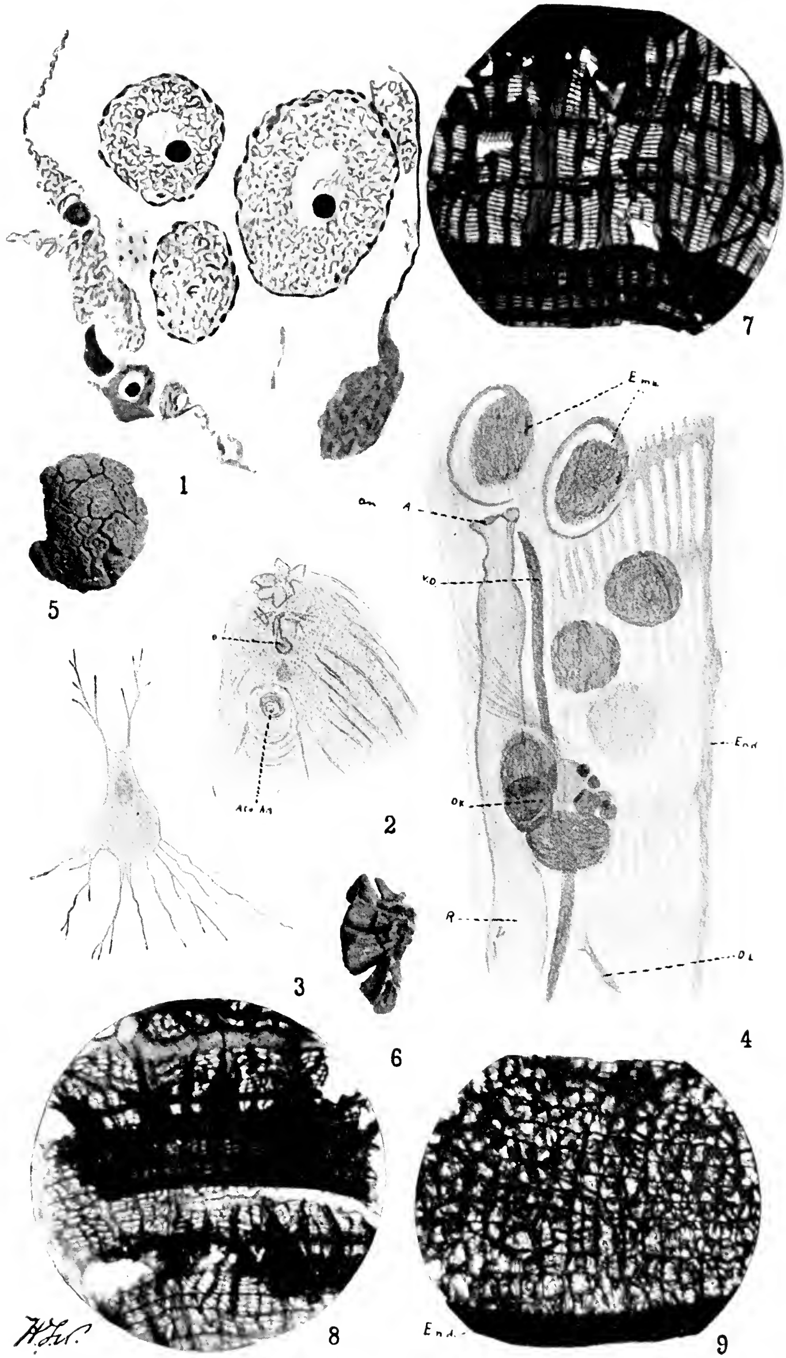
APPENDAGES (MALE) OF AUSTRALIAN GOMPHINÆ.



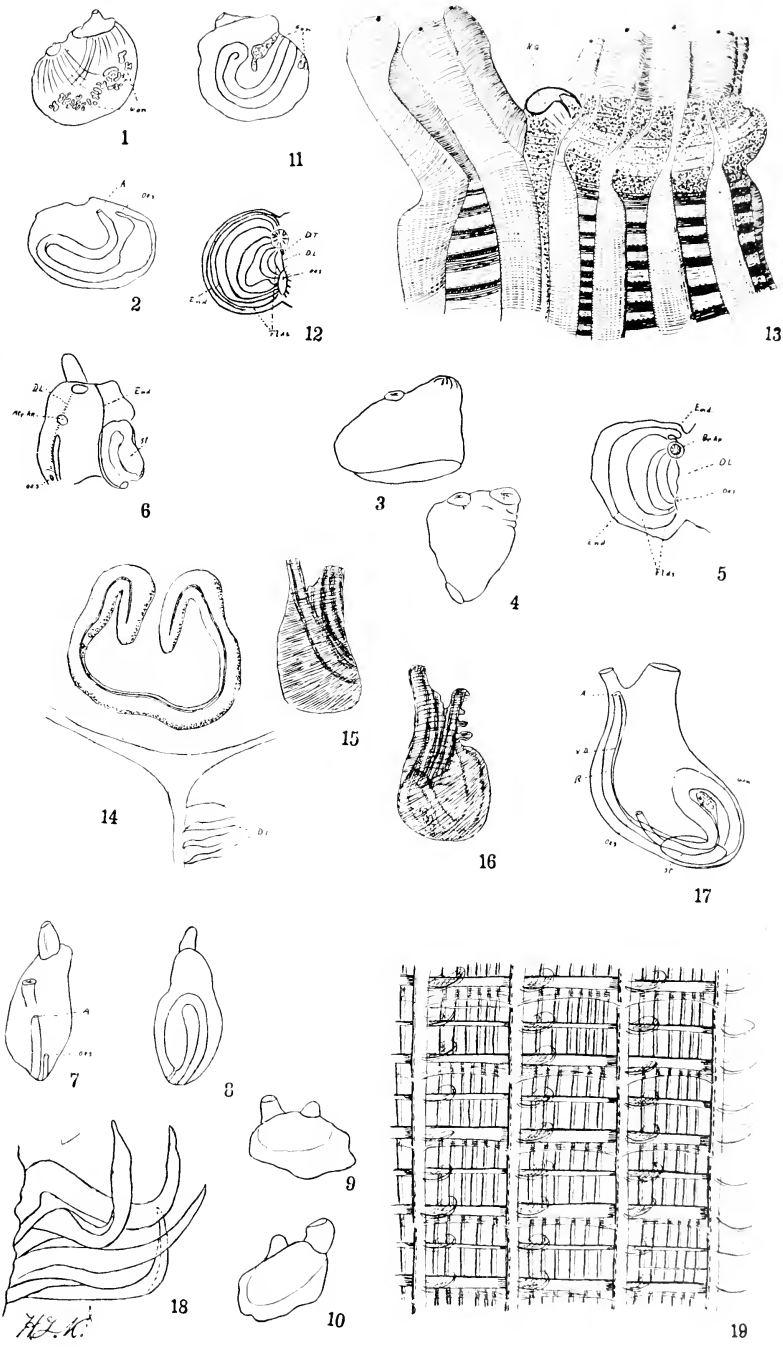
PETALURA GIGANTEA (LARVA)



AUSTRALIAN AND TASMANIAN TUNICATA.



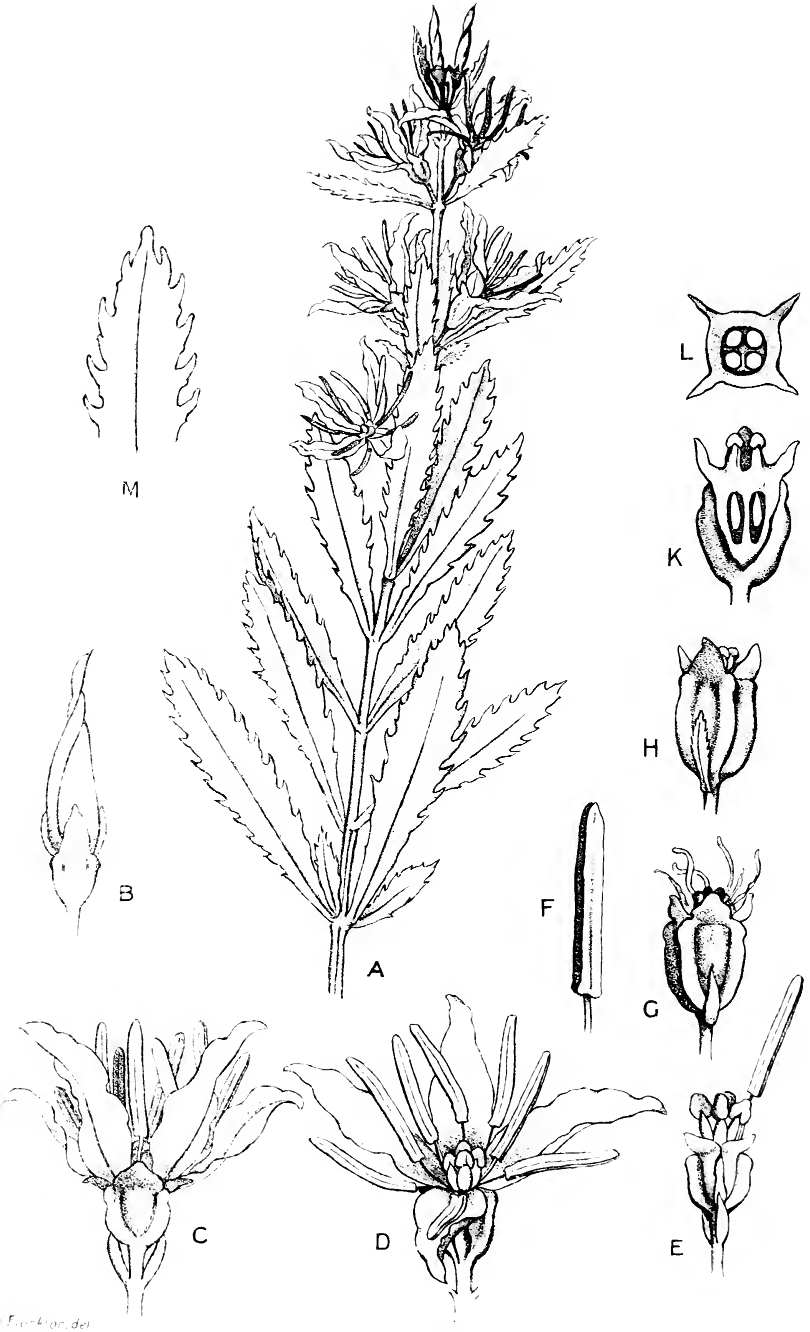
AUSTRALIAN AND TASMANIAN TUNICATA.



AUSTRALIAN AND TASMANIAN TUNICATA.

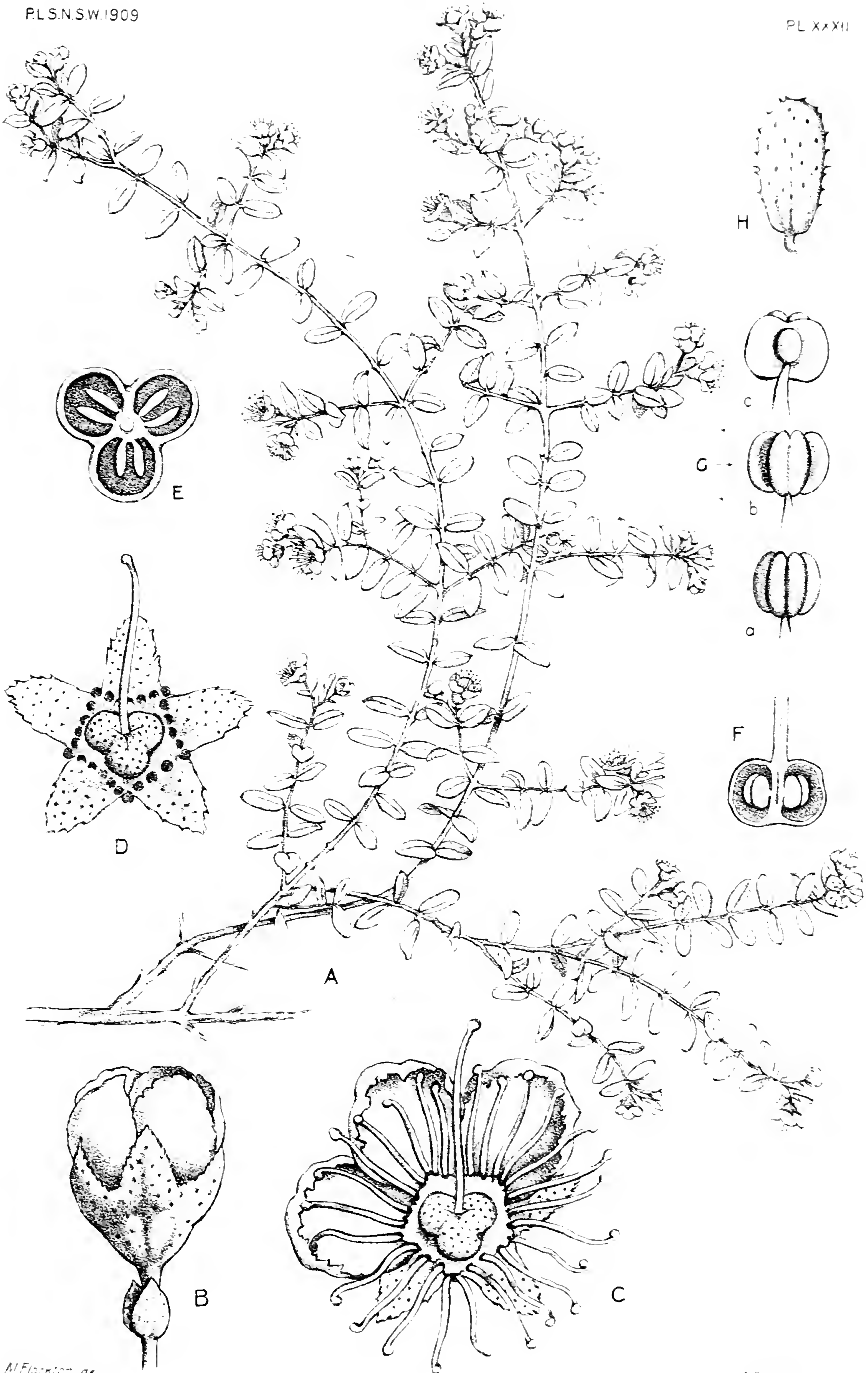
EUCALYPTUS PARVIFOLIA, n.sp.

EUCALYPTUS PARVIFOLIA, sp. nov.



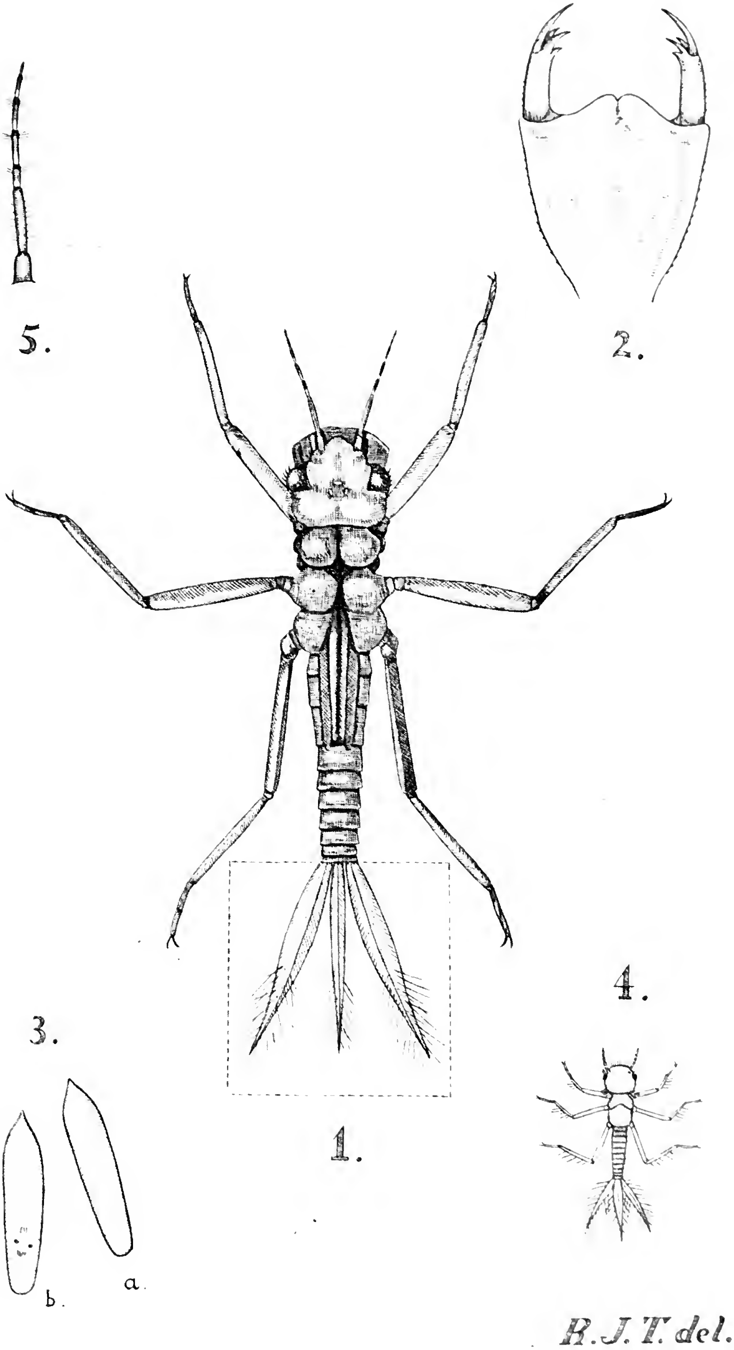
HALORRHAGIS LUCASI, n. sp.

H. J. A. Baron, lith.



M. Flockton, del.

BAECKEA DENTICULATA, n. sp.



DIPHLEBIA LESTOIDES Selys.

critical review, concludes that the evidence is in favour of opsonins and agglutinins having a similar structure.

Agglutination requires the presence of salts to bring about the phenomenon, and the same is probably true of opsonisation. They are undoubtedly necessary for the observation of phagocytosis because the leucocytes are destroyed in the absence of an isotonic solution. The theories regarding the nature of opsonisation do not take into account the salt which may be necessary for the opsonin to be fixed by (*i.e.*, precipitated upon) the bacteria, in order that the phenomenon of phagocytosis may take place.

I do not think that the function of the salt in opsonisation has ever been noted. It would not be an easy matter to obtain the opsonin free from salt, and we certainly could not demonstrate opsonisation without salt, for the phagocytes would be destroyed in a salt-free medium.

In considering the curve showing the action of dilution upon the opsonic activity of the serum, it might be well to admit, as a postulate, that the regular rise from infinity to the quarter dilution is due to the combined actions of the salt and opsonin, while the depressing substance, whatever it may be, is so dilute as to be thrown out of action. All salts, however, have not the same precipitating action. Chlorides are high in the scale, while phosphates and organic salts are low; and it may be that the depressing influence of the stronger percentage of serum is traceable to the presence of the latter. Upon the other hand, there may be a certain amount of antiphagin or similar substance in the serum.

In the experiments from which Dean obtained his curves, the average maximum number of cocci ingested per leucocyte varied from 10 to 23. This number may be considered to be high; as a rule, one obtains more concordant duplicate results when the maximum average is about five cells per leucocyte. With a suspension of bacteria which would give this phagocytic index, the curves might be different. Furthermore, the time of incubation will have a certain influence; there should be more irregularity in the dilution-curves with longer periods of incubation.

On the other hand, phagocytosis should proceed more slowly as the leucocytes become filled with bacteria; and, while this will cause the curve to have a convex shape, it does not explain why the curve should rise above unity as the serum becomes dilute.

The influence of thin suspensions of bacteria.—In accordance with these views, an experiment was made in which the suspension of staphylococci was of such an opacity that from 5 to 6 cells were ingested in 5 and 10 minutes by the leucocytes of the undiluted serum-test. The ratio of serum to corpuscles and bacteria in all the following experiments was the usual 1:1:1.

Incubation.	5 minutes.		10 minutes.	
	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.
Serum	4·8	1·00	6·4	1·00
,, diluted ½......... ..	4·5	0·94	5·7	0·88
,, ,, ¼..	3·0	0·62	4·4	0·69
,, ,, ⅛...	2·3	0·48	3·6	0·55
,, ,, 1/16	1·5	0·31	2·7	0·42

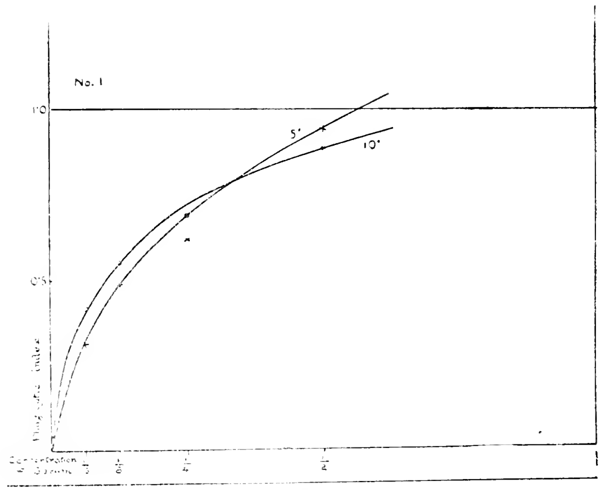


Fig.1.—Thin suspensions of bacteria.

These curves are interesting, inasmuch as they do not rise above unity from normal serum to the half dilution, and are quite different from the curve pictured by Dean. There is no upward pointing break at the quarter dilution.

The influence of varying thicknesses of the bacterial suspensions.—In this experiment, the strongest suspension was diluted two- and four-fold with 0·85 % saline, and the tests were incubated for 10 minutes at 37°.

Bacterial suspension.	Original.		Half strength.		Quarter strength.	
	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.
Serum...	16·2	1·00	9·6	1·00	5·3	1·00
,, diluted ½...	19·3	1·18	9·9	1·03	4·4	0·82
,, ,, ¼...	17·6	1·08	6·4	0·66	3·4	0·63
,, ,, ⅛...	10·2	0·62	5·0	0·52	2·1	0·40
,, ,, 1/16..	6·1	0·38	3·2	0·34	1·4	0·27

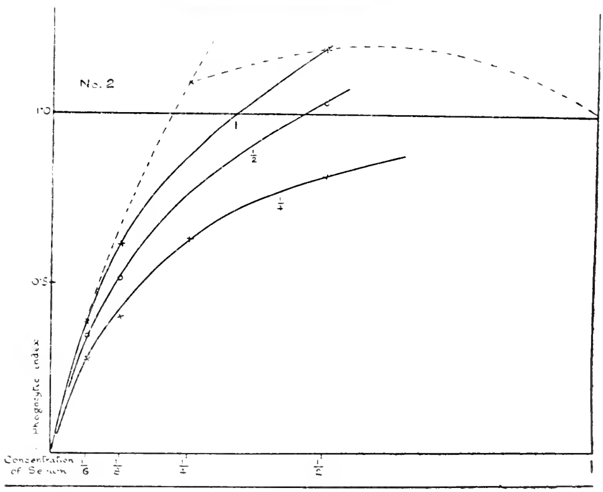


Fig. 2.—Varying thicknesses of the bacterial suspensions.

The experiment brings out several points. There is the gradual and uniform rise of the curve in the case of the thinnest suspension of bacteria. This confirms the previous experiment. With thicker suspensions, the curves rise more quickly and fall to unity; and, in the case of the thickest suspension in which 16 cells were englobed in the undiluted serum-test, there is a break at the one-quarter dilution. In this respect the curve is identical with that found by Dean. It may be said, however, that this was the only time that the typical Dean-curve was obtained; and, from a consideration of the later results in which dilutions between undiluted serum and a two-fold serum were tested, it appears probable that there should be no sharp break in the curve.

The quarter and eighth dilutions, however, appear to be points about which the curves deviate from regularity. As will be seen later, there is frequently obtained a more or less pronounced "hump" in the curve about these dilutions. In this experiment these "humps" may have occurred at the $\frac{1}{4}$ dilution with the thick suspension, at the $\frac{1}{8}$ with the medium, and slightly at the $\frac{1}{16}$ with the thinnest suspension.

Speaking generally, the number of bacteria ingested is assumed to be a measure of the amount of opsonin in the serum. This is true up to a certain point and under certain conditions, but beyond this the opsonic influence is affected by the conditions which influence phagocytosis. The saline content is such a condition. There may be either too little or too much salt in the serum to bring about a maximum phagocytosis under the conditions of the experiment.

The effect of adding salt to the serum.—In the following experiment the serum was treated with finely powdered sodium chloride in quantity to make a 0·85 % solution; and this was progressively diluted with 0·85 % normal saline.

Bacterial suspension.	Thick.		Thin ($\frac{1}{4}$).	
	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.
Salted serum (0·85%)......	3·35	1·00	1·18	1·00
,, ,, diluted $\frac{1}{2}$....	1·65	0·50	1·07	0·90
,, ,, ,, $\frac{1}{4}$....	5·16	1·54	1·73	1·50
,, ,, ,, $\frac{1}{8}$....	3·43	1·01	1·25	1·06
,, ,, ,, $\frac{1}{16}$...	2·50	0·75	0·35	0·30

We have here a great exaggeration of a break or "hump" at the quarter dilution. The main point that is to be inferred from

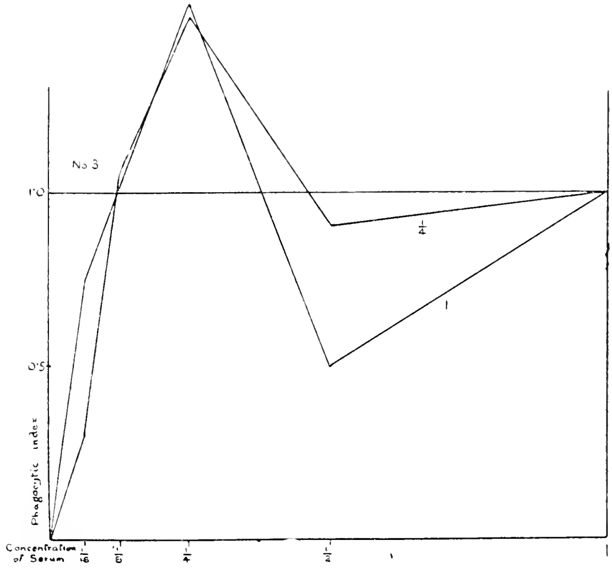


Fig.3.—Salted serum, with thin and thick bacterial suspensions.

the experiment is that the serum does not contain a deficiency of salt but an excess, and this is probably the chief reason for the rise of the curve upon dilution.

The low indices obtained with the undiluted serum are a direct effect of the added salt. A preliminary experiment showed that the addition of salt lowered the index to one-fourth.

The effect of adding distilled water to the serum.—The last experiment led to testing the effect of adding distilled water to the serum in varying proportions. The corpuscles and staphylococci were suspended in 0·85 % saline.

Vols. of serum...	9	8	7	6	5	4	3	2	1
Vols. of distilled water.......	1	2	3	4	5	6	7	8	9
Cocci per leucocyte...........	16·7	19·8	21·8	18·9	17·9	15·7	14·6	12·2	11·3

The maximum phagocytosis was obtained when seven parts of serum were mixed with three parts of distilled water.

The influence of time of incubation.—In the following the pipettes were incubated for periods of 10, 15, and 20 minutes at 37°. The dilutions were made with 0·85 % saline. It will be noted that, although the serum had not been previously treated with sodium chloride, the curves are, to a certain extent, of the nature of those obtained with salted serum. It would appear that, upon the day on which this experiment was made, there was a larger than usual amount of saline matter in the blood.

Period of incubation.	10 minutes.		15 minutes.		20 minutes.	
	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.
Serum.............. ..	20·7	1·00	25·8	1·00	26·8	1·00
,, diluted ½....	12·1	0·58	13·6	0·52	14·6	0·54
,, ,, ¼.. .	7·5	0·36	10·2	0·40	12·9	0·48
,, ,, ⅛....	8·5	0·41	12·6	0·49	21·7	0·81
,, ,, 1/16 ...	7·4	0·38	11·2	0·44	18·2	0·68

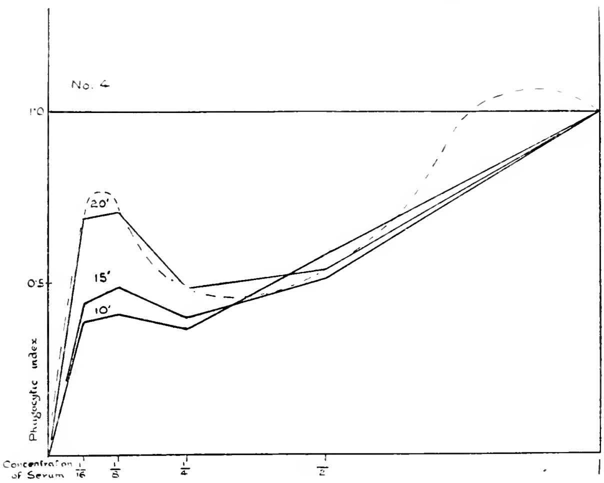


Fig. 4.—Duration of phagocytosis.

It will have been noticed that, as the serum is diluted, the curve may or may not rise above unity. Take curves Nos. 2

and 4 for example. The tests in No.4 were made with thick suspensions, and the curves should have risen above unity at the half dilution. A variable factor must come into play in the determinations. This cannot be the saline used in all cases; it is probably not the bacteria, for the same race was used; the time of incubation will not explain the variation. We are left with the serum and the leucocytes. But, in order to determine the variable factor as nearly as possible, all the constituents were tested for their influence upon the curves.

It will be noted that the "hump" is well marked in these curves; and it is possible that, had the dilutions of serum between the half and normal been tested, the ratios might have risen above unity, like the broken curve in the figure.

The influence of the serum.—The sera of three individuals were tested with the same suspensions of leucocytes and bacteria. The incubation was for 15 minutes, and the dilutions, etc., were made with 0·85 % saline. The phagocytic indices of these were 17·1, 15·9, and 16·5 respectively.

	Phagocytic ratios.			
	R.G.S.	H.J.G.	J.C.	Average.
Serum	1·00	1·00	1·00	1·00
,, diluted $\frac{1}{2}$	0·85	0·84	0·75	0·81
,, ,, $\frac{1}{4}$	0·52	0·55	0·52	0·53
,, ,, $\frac{1}{8}$	0·35	0·44	0·32	0·37
,, ,, $\frac{1}{16}$	0·28	0·40	0·22	0·30

There is a steady fall from unity of the average curve, which is a straight line between the $\frac{1}{16}$ and $\frac{1}{2}$ dilution. As there was little difference between the individual curves, it is evident that the serum does not give rise to the variations which have been observed in the curves.

The influence of the bacterial suspensions.—Three races of *Micrococcus aureus*, which had been isolated at different times, were tested in the same manner as in the previous experiment. The phagocytic indices were 19·4, 15·7, and 11·7 respectively.

	Phagocytic ratios.			
Days since Race was isolated.	200	42	11	Average.
Serum	1·00	1·00	1·00	1·00
,, diluted ½	0·75	0·75	0·72	0·74
,, ,, ¼	0·58	0·55	0·55	0·56
,, ,, ⅛	0·62	0·46	0·52	0·50
,, ,, 1/16	0·44	0·33	0·44	0·40

The average curve falls very regularly, and is virtually a straight line between unity and the one-eighth dilution. The individual curves run close together to the ⅛ dilution, when the oldest race shows a more pronounced rise than the others. Still there is nothing to account for the observed irregularities in the curves from time to time.

Bacteria which have been heated and partly freed from anti-opsonin by washing, show a greater facility for being ingested by the phagocytes at the half- and quarter-dilution compared with the unwashed bacteria. In the following, the bacteria were suspended in saline, and heated at 60° for an hour; then sedimented in the centrifuge, and finally suspended in saline. Bacteria suspended in the usual way were used for comparison. The indices with undiluted serum were 13·7 and 17·7 respectively.

	Ratios.	
	Heated and washed cocci.	Control.
Serum	1·00	1·00
,, diluted ½	0·87	0·68
,, ,, ¼	0·59	0·47
,, ,, ⅛	0·39	0·40
,, ,, 1/16	0·32	0·35

The influence of the saline.—Dean, in his work upon the effect of dilution upon the opsonic curve, makes no mention of strength of the saline which he employed for making the dilutions, and for suspending the corpuscles and bacteria. That the strength may have an influence, is probable, in view of the previous results obtained when the serum was salted.

In the following experiments the leucocyte "separate" was mixed, and equal volumes were distributed in various strengths of saline, and centrifugalised. Equal volumes of a bacterial suspension in distilled water were mixed with similar volumes of saline of double strength. The serum was diluted with the various salines. The period of incubation was 15 minutes.

Strength of saline.	0·7 %		0·85 %		1·0 %	
	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.
Serum	17·5	1·00	17·0	1·00	16·4	1·00
,, diluted ½	19·0	1·09	18·3	1·08	10·7	0·65
,, ,, ¼	10·8	0·62	9·1	0·53	4·8	0·30
,, ,, ⅛	7·4	0·42	4·3	0·25	3·3	0·20
,, ,, 1/16	6·8	0·39	3·9	0·23	1·3	0·08

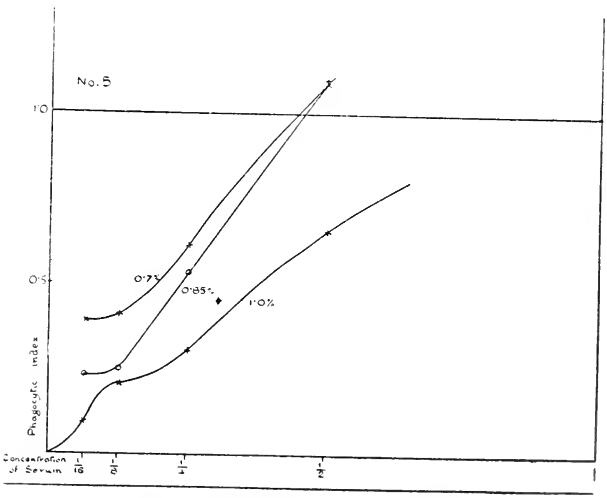


Fig. 5.—Saline of various strengths.

A similar experiment was made at a later date, when the necessity of using dilutions of serum stronger than one-half had been shown. The tests were incubated for 10 minutes.

Saline.	0·8 %		1·0 %		1·2 %	
	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.
Serum...............	15·1	1·00	12·3	1·00	10·7	1·00
,, diluted ⅞.....	16·7	1·10	13·0	1·05	6·1	0·57
,, ,, ¾.....	16·3	1·08	12·3	1·00	5·6	0·53
,, ,, ½.....	13·5	0·89	9·5	0·77	3·6	0·34
,, ,, ¼.....	7·8	0·52	5·4	0·44	1·5	0·14
,, ,, ⅛.....	6·0	0·40	3·5	0·28	1·0	0·09

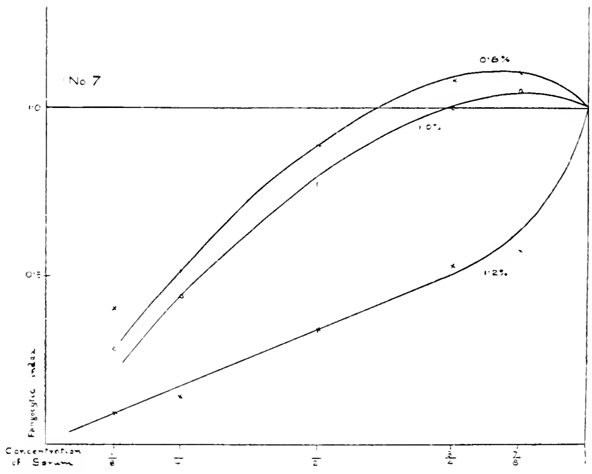


Fig. 6.—Saline of various strengths.

It will be noted from these results that the strength of saline employed has a pronounced effect upon the nature of the dilution curves. Further examples will be seen in the curves which follow

The influence of the leucocytes.—According to Bushnell* and to Briscoe,* the leucocytes vary in their avidity for bacteria, and it may be that, by using the separate,† a variable proportion of different kinds of phagocytes are obtained upon different occasions. In the paper just noted, I have shown how light and heavy leucocytes may be separated; and, as these have different capacities for bacteria,‡ they might exert different actions so as to produce differences in the dilution-curves. Their respective actions were compared in conjunction with various strengths of saline.

Strength of saline.	0·6 %				0·8 %				1·0 %			
	Cocci per leucocyte.		Ratio.		Cocci per leucocyte.		Ratio.		Cocci per leucocyte.		Ratio.	
	light.	heavy.	light.	heavy.	light.	heavy.	light.	heavy.	light.	heavy.	light.	heavy.
Serum	11·3	11·6	1·00	1·00	11·6	10·4	1·00	1·00	10·9	11·8	1·00	1·00
,, diluted ½......	11·8	11·8	1·04	1·02	10·4	12·5	0·91	1·20	10·1	10·8	0·93	0·92
,, ,, ¼......	10·0	9·3	0·88	0·80	8·3	9·6	0·71	0·92	5·1	5·7	0·46	0·48
,, ,, ⅛... .	6·3	6·7	0·54	0·58	4·5	5·3	0·39	0·51	3·7	4·0	0·34	0·34

Curves prepared from these results show that the phagocytic action in saline of 0·6 % and 1 % concentration is very much the same, while 0·8 % saline shows a distinct difference.

The experiment makes it appear probable that one reason for obtaining sometimes a curve which rises above the unity line, and, at others, a curve which falls below unity, is that there are differences in the relative proportions of the various corpuscles.

It is curious that, while the phagocytic index of the light corpuscles in the 0·8 % saline is higher than the heavy, as was found on a former occasion, the order is reversed upon dilution.

* Brit. Med. Journ. Nov. 16th, 1907, 1422, 1423.

† These Proceedings, 1908, 680.

‡ *Ibid.*, p.685.

In the next experiment, the action of the light, as compared with the heavy leucocytes, was again tested in 0·8 % saline; and, believing that further information might be gained by using concentrations of serum between the half-dilution and a normal serum, a three-quarter dilution was employed.

With regard to the leucocytes, these were obtained by washing the total corpuscles in 0·85 % saline until they were considered to be free from serum; they were then suspended in a small quantity of saline, transferred to cylindrical tubes, and the volume made up to a depth of 1·75 inches. The tubes were rotated very slowly in the centrifuge for 600 revolutions of the spindle, after which the bottom half-inch of suspension was removed. This contained the heavy phagocytes, the supernatant suspension holding the light leucocytes. This process was repeated several times with the portions until it was considered that the heaviest and the lightest phagocytes had been separated. The suspensions were measured and divided into portions, each of which was washed with the strength of saline desired for the experiment.

Nature of leucocytes.	Light.		Heavy.	
	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.
Serum	9·0	1·00	8·8	1·00
,, diluted $\frac{3}{4}$	11·3	1·24	10·4	1·18
,, ,, $\frac{1}{2}$	8·9	0·98	9·3	1·06
,, ,, $\frac{1}{4}$	4·9	0·54	5·6	0·63
,, ,, $\frac{1}{8}$	3·8	0·51	4·1	0·46

The curves show a marked rise with the three-quarter dilution, which is more than would have been expected from a consideration of the curves in its absence. The reversal of the relative heights of the curves at the three-quarter dilution is noteworthy.

A final experiment was made, partly to endeavour to obtain a straight curve, and partly to determine the influence of thin and

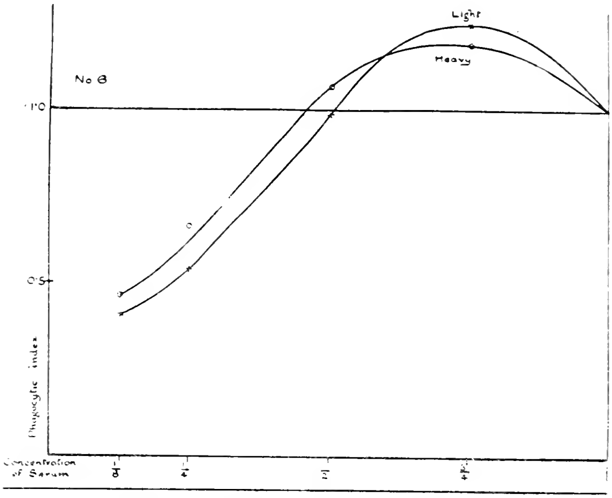


Fig.7.—Light and heavy leucocytes.

thick suspensions of cocci. The thick suspension was diluted with two parts of saline of the same percentage. The pipettes were incubated for 10 minutes, the usual leucocyte "separate" being employed; and, as in the previous experiment, the bacteria were suspended in distilled water, and diluted with equal volumes of salines of double strength.

Saline.	0·8 %				1·1 %			
Bacterial suspension.	Thick.		Thin ($\frac{1}{3}$).		Thick.		Thin ($\frac{1}{3}$).	
	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.	Cocci per leucocyte.	Ratio.
Serum..................	21·6	1·00	7·8	1·00	13·2	1·00	6·5	1·00
,, diluted $\frac{7}{8}$........	22·8	1·06	8·0	1·04	(14·1)	(1·06)	4·9	0·75
,, ,, $\frac{3}{4}$.......	23·8	1·10	7·7	1·00	11·5	0·87	3·3	0·51
,, ,, $\frac{1}{2}$.......	21·0	0·97	6·7	0·87	8·3	0·67	2·6	0·40
,, ,, $\frac{1}{4}$........	14·9	0·69	4·0	0·52	4·6	0·37	0·8	0·13

It is seen, from the last experiments, that the curve always rises from unity to the half-dilution. The dilution-curve, as

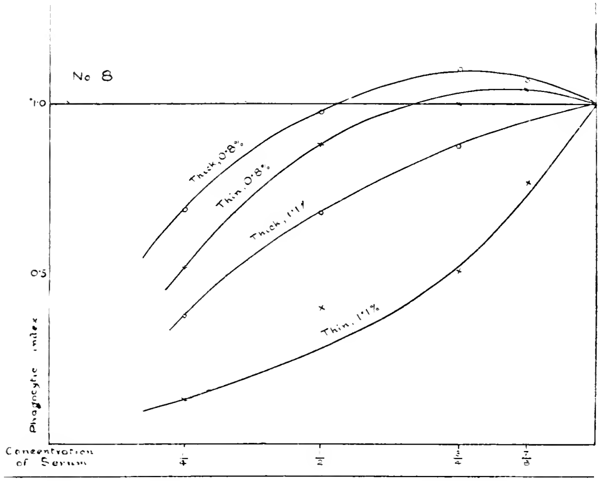


Fig. 8.—Thick and thin suspensions of bacteria with different salines.

represented by Dean, would therefore appear to be misleading; and a curve of a different order would have been obtained, had he examined dilutions between normal and half-strength.

The curve becomes almost a straight line when the saline contains from 1·0 to 1·1 % of sodium chloride, and when certain thicknesses of bacterial suspension are employed. What these are, can be determined only by experiment, for there appear to be slight daily variations which prevent any definite information being given.

Conclusions arrived at from the experiments.—The investigation has shown that several factors have each an influence in modifying the nature of the curve representing the opsonic and phagocytic effects obtained upon progressively diluting normal serum. The most important of these is the strength of the saline employed. It would be possible to obtain the phagocytic indices so that their ratios lay upon a straight line, by using a solution of sodium chloride containing from 1·0 to 1·1 %. As, however, the thickness of the bacterial suspension, the time of incubation, and the nature of the phagocytes have each a certain influence upon the results, these would have to be taken into account.

Next to the saline, the thickness of the bacterial suspensions produces the greatest variations in the curves; the thicker the suspensions, the greater are the divergences from the straight line. The greater the phagocytosis, the more does the high saline-content of the normal serum make itself manifest by increasing the convexity of the curves.

A local slight rise and fall (a "hump") is generally obtained at the $\frac{1}{8}$ and $\frac{1}{4}$ dilutions.

The higher phagocytic indices that are obtained upon diluting serum with saline, are occasioned by the total salinity of the mixture, in which phagocytosis occurs, being lowered to a density which is more favourable for phagocytosis.

Summary.—The regularity of the phagocytosis of staphylococci, in the presence of normal serum progressively diluted, is influenced by the following in their order, the first being the most important.

1. The strength of the saline.
2. The thickness of the bacterial suspension.
3. The nature of the phagocytes.
4. The duration of the phagocytosis.

ON SOME HÆMOGREGARINES FROM AUSTRALIAN REPTILES.

By T. Harvey Johnston, M.A., B.Sc., Assistant Government Microbiologist.

(From the Bureau of Microbiology, Sydney.)

(Plates xxxiv.-xxxv.)

Australian Hæmoprotozoa have been quite neglected until very recently. To this group there belong a number of families, to one of which, the *Hæmogregarinidæ*, the organisms described in the present paper refer. These are from reptiles, chiefly snakes.

The *Hæmogregarinidæ* constitute a family belonging to the Sporozoa, and the main characters, as given by L. W. Sambon,(1) are the possession of a definite form which is generally club-like, the wider end being regarded as anterior; the complete absence of black pigment; and the presence of a capsule, except in very young stages. The adult parasite commonly becomes somewhat bent on itself by the growing round of the posterior narrower end in such a way that it comes to lie against the main part of the organism.

The absence of pigment, and the presence of a definite form enclosed in a capsule, allow of the ready separation of hæmogregarines from species belonging to other hæmoprotozoan genera such as *Babesia* (*Piroplasma*), *Halteridium*, *Hæmocystidium*, and *Plasmodium*, including their very numerous synonyms such as *Proteosoma*, etc.

The genus *Leucocytozoon* is now regarded as a synonym of *Hæmogregarina*, since, in some hosts, the same kind of parasite may occur in the leucocytes as well as in the erythrocytes (*e.g.*, *Hæmogregarina colubri* Börner, and *H. rarefaciens* Samb. &

Seligm.). However, this is not commonly the case. Other genera have been proposed, whose characters are based mainly on the relative sizes of the host-cell and the parasite; but I intend to follow Sambon in regarding the family as consisting of a single genus, *Hæmogregarina* Danilewsky (Laveran emend.).

Sambon(1) states that these animals pass through a cycle in their life-history, which in many ways resembles that described for malaria parasites(*Plasmodium* spp.). Reproduction may be brought about by sporogony or by schizogony, *i.e.*, sexually or asexually, respectively. In the asexual stage, the cycle is passed through in the blood of a vertebrate (schizogony); whilst the sporogonic, or sexual phase, occurs in the body of some blood-sucking ectozoon such as a tick or louse, in the case of land-animals; or a leech, in the case of aquatic hosts. Thus the final or definitive host (*i.e.*, the host in which the parasites become sexually mature) is an ectoparasite, whilst the intermediate host is one of the higher animals. He also states, further, that in the intermediate host, two different adult organisms may be produced, viz., the schizont and the sporont. The schizont is known to break up into a number of merozoites which become liberated into the blood-plasma, and may infect blood-corpuscles of the same host. The sporont is destined for removal by the definitive host, on reaching whose gut it gives rise to micro- and macrogametocytes. These conjugate to become ookinites capable of again entering and reinfecting the vertebrate when occasion offers, *i.e.*, they may become extruded with the saliva of the ectoparasite, whilst it is sucking its host's blood. I have not seen schizonts in any of the films examined. Perhaps their appearance is periodic.

So far very few Hæmogregarines are known from Australia. They are

(a) *Hæmogregarina shattocki* Sambon and Seligmann,(1, 2) from an Australian diamond-snake, *Python spilotes* Lacép.

(b) *H. dasyuri* Welsh and Barling,(3) from the "Native Cat," *Dasyurus viverrinus* Shaw (New South Wales).

(c) *H. petauri* Welsh, Dalyell and Burfitt,(4) from a marsupial "squirrel," *Petaurus sciureus* Shaw (New South Wales).

(d) *H. amethystina* Johnston,(6) from the Northern carpet-snake *Python amethystinus* Schn.(North Queensland).

Of the above, the first and the fourth have been met with in our work at the Bureau of Microbiology, and in addition, *H.* (*Leucocytozoon*) *muris* Balfour (5),originally described from the Egyptian Sudan, has been met with on a few occasions(7) in the sewer-rat (*Mus decumanus* Pallas) in Sydney during our plague-investigation work. Dr. J. B. Cleland(8) recorded the occurrence of the same parasite from this rat in West Australia under the names *Leucocytozoon ratti*, and *L. balfouri* Laveran, the former name being a slip, whilst the latter name would be the correct one if further investigation should show that *H. balfouri* (*L. jaculi*) Lav., of the Jerboa, and *H muris* of the rat, are specifically the same.

Although I have examined blood-films from a large number of birds, mammals, lizards, frogs, and fishes, the presence of hæmogregarines has not been detected in them, though species of other hæmatozoa, such as *Halteridium*, *Plasmodium*, *Babesia*, and *Hæmocystidium* were seen, many of them having been described recently by Dr. Cleland and myself. The Hæmogregarines described below were met with in our Bureau work.

Hæmogregarina shattocki Samb and Seligm.(2)

(Plate xxxiv , figs.13-20).

In 1907, Sambon and Seligmann(2) described the above species from the erythrocytes of an Australian diamond-snake, *Python spilotes* Lacép., which died in the Zoological Gardens, London. They mentioned(1) that this snake occurs in Australia, and New Guinea. The true diamond snake has a very restricted range, being found only along the coastal districts from Broken Bay to Jervis Bay, and the adjacent mountain slopes; whilst the variety of it, *P. spilotes* var. *variegata* Gray, better known as the carpet-snake, is found all over the continent. I am inclined to take the popular and scientific name mentioned by these authors. The range given will, in that case, need altering, and we may take it for granted that the specimen came from New South Wales.

Mr. H. Wasteneys, of Brisbane, recently forwarded several blood-films from carpet-snakes (*P. spilotes* var. *variegata* Gray) captured on the Enoggera Water-Reserve (near Brisbane). Two of the films showed the presence of comparatively few hæmogregarines, which I have identified as *H. shattocki.* Many of the adult stages described for this species were not present in the specimens examined, but the forms seen resembled those described sufficiently closely to justify the identification.

The youngest parasite seen was only about 6 μ long by about 2·5 μ wide. It did not possess the fairly characteristic shape of a young hæmogregarine. Its centrally situated nucleus was comparatively large, round, and deeply staining. The parasite was about as large as the host-nucleus. It is worth noting here that its host-cell harboured another much larger specimen, this being the only example of double infection seen in the several films examined. The other form was a typical crescent-shaped hæmogregarine. Many of the latter type were seen, their measurements being about 15 μ by 2·5 μ, measuring the length along the middle of the parasite. The ends gradually tapered for a short distance, and terminated in blunt, rounded extremities of equal size. Hence one could not distinguish definitely an anterior and a posterior end in each. The concavity of the crescent was usually facing the host-nucleus, which was not in any way displaced. The nucleus of the organism, when visible, appeared as a definite band across the body, usually slightly nearer one end than the other. A thin capsule could, in most cases, be detected.

These crescentic forms correspond fairly closely to Sambon and Seligmann's, which were from 11 to 15 μ long by 2 μ broad, and possessed rounded extremities differing only slightly in thickness.

In later stages, a capsule could be distinguished quite readily. Sometimes it lay some little distance from the parasite, especially on the concave side; sometimes the interval was very narrow.

These organisms were rather shorter and broader than the crescents, being from 12 to 14 μ long, by about 3 μ wide. Since the erythrocytes are only about 19 μ by 10 μ, the adult sporont (the stage represented in our specimens) necessarily becomes bent, as previously stated. Such forms are figured by Sambon.(1) That these later stages represented sporonts and not schizonts, was recognisable by their structural characters. They were more or less club-shaped, one end being, however, only slightly broader; their nuclei were situated, as a rule, near the middle, and were generally well defined, consisting of a rather open chromatin network extending across the organism in a band-like manner; and the cytoplasm did not possess the refractive granules characteristic of schizonts.

The host-cells were not distorted, though their nuclei were frequently pushed aside and lay close to the edge, often nearer one end of the erythrocyte.

HÆMOGREGARINA MORELIÆ, n.sp.

(Plate xxxiv., figs.1-12.)

My colleague, Dr. J. B. Cleland, handed over to me, for examination, a number of blood-films from Western Australian animals, including a tortoise, *Chelodina oblonga* Gray(?), and a carpet-snake, *Python spilotes* var. *variegata*.

The snake was captured on the Abrolhos Islands, a small group off the west coast of West Australia. A blood-film taken from it showed the presence of numerous hæmogregarines in the red cells. These appeared to me to differ from *H. shattocki* in several details, and, consequently, a new species is proposed for them. It is quite possible that further investigation of the hæmogregarines of the carpet-snake may lead to the fusion of this species with *H. shattocki*. The examination of the blood from parasitised carpet-snakes taken at localities between these two extreme parts (eastern and western) of the continent would settle the validity or otherwise of the proposed species. For the specific name, I have borrowed the old generic name (a synonym) of this reptile (*Morelia variegata* Gray).

The corpuscles were from 18-20 μ long, by 10 or 11 μ broad, with nuclei averaging 7 by 4·5 μ. The parasites varied from 10 to 19 μ in length, and from 1·5 to 5 or 6 μ in greatest breadth. The largest forms measured 20 μ by 4 μ, and 17·5 μ by 6 μ; whilst the smallest were 12 by 1·5 μ, and 10 by 4 μ.

Even the largest hæmogregarines, some of which occupied nearly the whole of the available space in the host-cell, *i.e.*, the nucleus excluded, did not cause any distortion of the erythrocyte, though the host-nucleus was usually displaced, even by moderately large parasites. Only exceptionally was its position so much altered that it rested against the edge of the red corpuscle.

Only one very young form, about 6 by 2 μ, was detected. It was placed transversely, towards one end of the host-cell. Crescentic parasites were rather uncommon, adult sporonts greatly predominating. The last varied considerably in shape. Some were club-shaped, with a very wide rounded anterior part which tapered to a much narrower, though still blunt, posteiior end. Others were very long and somewhat narrow, the posterior end being bent round in an open curve. Others again were nearly uniform in breadth throughout, whilst still others possessed the typical adult-form in which the "tail" was bent round in such a way as to lie close to the "body." The parasites were usually of greatest breadth in the region of the nucleus, a distinct bulging being seen on the inner (*i.e.*, the concave) side.

The nucleus was generally broad and band-like, though occasionally it was small and irregular, or rounded. Its position was somewhat nearer one end.

The capsule was somewhat similar to that seen in *H. shattocki*, but appeared to be more delicate.

In brief, the main difference between *H. moreliæ* and *H. shattocki* is, that the sporonts of the former are rather shorter and much wider. *H. pococki* Sambon and Seligmann, from *Python molurus* Linn., is evidently a close ally to this species.

The type-slide has been presented to the Australian Museum, Sydney.

HÆMOGREGARINA PSEUDECHIS, n.sp.

(Plate xxxv., figs.13-20.)

A black snake, *Pseudechys porphyriacus* Shaw, obtained near Sydney, was found to be parasitised by hæmogregarines which were not by any means abundant.

The host-cells were about 15 μ by 10 μ, with nuclei 7·5 μ by 4 μ; whilst the parasites were generally about 14 μ by 3·5 μ. In addition to these typical hæmogregarines, there were present a number of very small parasites with a definite non-amœboid shape which was rounded, elongate or pyriform. These measured 3 or 4 μ long by 1·5 μ broad, and, no doubt, represented very early stages. If we except these very small forms, the youngest hæmogregarines appeared as large, slightly club-shaped bodies, with a thicker, rounded, anterior end tapering very gradually towards the blunt, and slightly curved, posterior extremity. These were from 12 to 14 μ long, by from 3 to 4 μ wide. A few specimens possessed a swelling on the concave side in the region of the nucleus. Their nuclei were broad and band-like, and were generally placed towards one or other end. The capsules were very delicate, and, as a rule, were not easily distinguishable. The only effect produced on the host-cell by the presence of the parasite was the displacement of the nucleus to the edge of the erythrocyte.

Adult forms were less bulky, and showed delicate but very distinct capsules which were not closely adherent to the parasites, especially on the concave side. Their sizes were 13 or 14 μ, by about 4 μ. In a few cases the posterior end was bent round in a manner similar to that mentioned in *H. moreliæ*. The central portion was bulged out on the inner side, the nucleus generally lying just anterior to it. As a rule, the concavity of the animal faced the host-nucleus, the latter being displaced laterally, though, in some instances, the displacement was towards one end of the red cell. No distortion of the host-cell was observed.

The generic name of the host has been borrowed as a specific name for the parasite. A type-slide has been presented to the Australian Museum, Sydney.

HÆMOGREGARINA CLELANDI, n.sp.

(Plate xxxv., figs.1-12.)

Dr. J. B. Cleland, while in Perth, took some blood-films from the common West Australian tortoise, *Chelodina oblonga*(?) Gray, the erythrocytes of which, on being stained with Giemsa, were seen to be rather heavily infected with a relatively broad hæmogregarine.

The sporonts were apparently of two types, which may represent some sexual differentiation. In the one type the parasites were lightly staining, and showed a number of structures resembling vacuoles. Sometimes there was only one, this being situated mostly at one end; sometimes there were one, two, or more at each end, their number, position, size, and shape being variable. Occasionally they were near the centre. The other forms were generally larger, more deeply staining, and non-vacuolated. Do the former represent male sporonts, and the latter female? These parasites ranged from 11 by 5 μ to 13 by 7 μ, the uninfected host-cells being from 18-20 μ long, by 10-12 μ broad; whilst infected host-cells were considerably larger, reaching from 20-24 μ in length, by from 10-13·5 μ in width.

There were many young stages represented, some of the parasites being only a little longer than the host-nucleus (7 μ by 4 μ). They were not encapsuled, and were usually vacuolated. The positions which they occupied in their hosts were very varied. Some lay transversely, with the concavity facing the host-nucleus in some cases, and remote from it in others. Sometimes they were placed longitudinally, either laterally, or along the median line of the host. The most usual position was somewhat oblique from the longitudinal axis of the erythrocyte. Even in the case of adult forms, it was quite exceptional to see any instances where the parasite was occupying the position usually taken up by hæmogregarines, *i.e.*, longitudinally between the nucleus (usually somewhat displaced laterally), and one side. Almost invariably was the host-nucleus displaced even by young forms. Another fact worth mentioning is that the displacement was in such a direction that the nucleus came to lie at or near one end, instead of laterally. The infected cells were distorted along the axes, hence their shape was not much altered, though their size was considerably increased.

Each adult parasite possessed a very definite, wide capsule, generally elliptical in shape. There was a comparatively wide interval between it and the organism. The outline of the latter was much more regular than is usually the case in members of the genus, the parasites being rather plump. In only one instance, a short recurved "tail" was seen, lying close against the rest of the "body."

Many free forms were present in the plasma; but since they were encapsuled, and were generally adjacent to crushed nuclei, we may assume that the condition was produced in making the film. The leucocytes were not infected.

The name *Hæmogregarina clelandi* is proposed for this species, in recognition of Dr. Cleland's work on West Australian parasitology. The type-slide has been presented to the Australian Museum, Sydney.

Other hæmatozoa described from Australian tortoises are *Trypanosoma chelodina* Johnson,(10) from *Chelodina longicollis* Shaw, from Morgan, South Australia; and *Hæmocystidum chelodinæ* Johnston and Cleland,(9) from the same species, obtained near Sydney

As some authorities have stated that trypanosomes and hæmogregarines may be stages in the life-history of one organism, it will not be out of place to mention the main characters given by Dr. A. E. Johnson, of Adelaide, in his brief, unfigured account of *Trypanosoma chelodina*, especially as it appears in a medical journal which very probably may not be available to biologists in other parts of the world.

These parasites, which, in stained films, were bent in the form of a semicircle, were larger than the nucleated discs, measuring about 14 μ long by 1·5 μ wide; but, if the undulating membrane were included, the breadth was from 2·5μ to 3μ. The flagellum, which was 2μ in length, was fringed, and ended at the centrosome. The latter was situated at about one-third of the distance from the centre of the posterior end, the nucleus lying between it and the centre. A large vacuole appeared to be present in the deeply staining protoplasm (using Leishman's stain). Towards each end this protoplasm was replaced by some deeply staining granules.

There was no trace of any trypanosomes in any of the reptilian blood-films examined by me. *Trypanosoma lewisi* Kent, is fairly commonly met with in our rats (*Mus rattus* Linn., *M. alexandrinus* Geoffr., and *M. decumanus* Pall.). *Hæmogregarina muris* Balfour, also occurs in New South Wales, in *Mus decumanus* Pall. Though I have examined films containing each of these, no film has been seen with both of them present. There is most probably no connection whatever between them.

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EXPLANATION OF PLATES XXXIV.-XXXV.

Plate xxxiv.

Figs. 1-12.—*Hæmogregarina moreliæ*, in erythrocytes of *Python spilotes* var. *variegata*.

Fig. 13.—Erythrocyte of *Python spilotes* var. *variegata*.

Figs. 14-20.—*Hæmogregarina shattocki*, in erythrocytes of *Python spilotes* var. *variegata*.

Plate xxxv.

Fig. 1.—Erythrocyte of *Chelodina oblonga*.

Figs. 2-12.—*Hæmogregarina clelandi*.

Fig. 13.—Erythrocyte of *Pseudechys porphyriacus*.

Figs. 14-20.—*Hæmogregarina pseudechis*.

Figs. 14-15.— ,, ,, ; young forms.

NOTES AND EXHIBITS.

The President exhibited a spoon of native manufacture, recently brought from the Solomon Islands by Count Mörner.

Mr. D. G. Stead showed specimens of the common "Drill or Boring Whelk" (*Trophon paivæ*), and he described its depredations upon oysters. He also exhibited the denuded tests of a remarkable and very variable, flat, South American echinoderm, *Encope emarginata* (Leske), obtained from sand-ballast, discharged from a barque at Newcastle, N.S.W.

Mr. E. J. Goddard exhibited a sample of water from a freshwater aquarium, swarming with a relatively large, ciliate infusorian (*Spirostomum* sp.), from 2·5-3 mm. in length: a mounted specimen of a marine leech, *Branchellion* sp., from the neck of a turtle, with only 7 or 8 pairs of foliaceous branchiæ instead of the more usual number, 30-33 pairs; the species was figured by Dr. MacDonald in Trans. Linn. Soc. London, Zool. (2), i., p.211, Pl. xxxiv., 1876, but without description: an example of an undescribed species of *Branchellion* allied to *B. torpedinis* of European seas: and certain minute structures occurring in an irregular manner over the neck of a species of *Pontobdella*, which were regarded as spermatophores by MacDonald, but which more probably represent the stalks of a solitary endoproctous polyzoon, as they contain an abundant musculature

Mr. John Mitchell, of Newcastle, sent, for exhibition, two valves of a fossil crustacean (*Estheria* sp.), with the following Note on their occurrence in the Newcastle and Illawarra Coal-Measures: "Recently I have found a number of valves of the Phyllopod, *Estheria* sp., in a very good state of preservation, in a thin band of clay-ironstone, about 15 feet below the seam of coal locally known as the Dirty Seam (No. 3 Seam from the surface at Shepherd's Hill, and in the Merewether Beach Cliff) and about on the same horizon as that from which I had previously obtained insect-remains. In 1893, while examining the country in the vicinity of the South Bulli (Bellambi) Colliery, I obtained a pair of valves of a crustacean, apparently of the same species as the Newcastle form, in similar strata to those in which the Newcastle fossils occur, and associated with *Glossopteris*. The occurrence of *Estheria* sheds a little additional light on the geological conditions obtaining during the deposition of this series of rocks."

Mr. Kesteven exhibited sections of the cervical cord of a dog, and mesial, sagittal sections of the brain of *Hyla aurea* treated as follows—(1) fixed in absolute alcohol; (2) cleared in cedar oil; (3) embedded in paraffin; (4) cut, and mounted by the water (method; (5) mordanted in Müller solution at 45°C., 48 to 76 hours; (6) stained in 1 % hæmatoxylin and 2 % acetic acid, 2-4 hours; (7) differentiated in (A) 25 % potassium permanganate, (B) 2 % oxalic acid + 2 % potassium sulphite, equal parts; (8) washed in a weak alkaline solution. Although the staining is a modified "Weigert-Pall," the results are completely different, axis-cylinders, nerve-cells (tyroid substance), and the nuclei of all cells staining black or brown, all other tissue remaining quite unstained. The advantages of the new stain are that the differentiation does not take place rapidly, so that one may successfully treat a large series on a slide; and the whole process may be completed in five or six days. Since the fixation is by absolute alcohol, the method is limited to small brains or small pieces of tissue, but it should prove extremely useful for studying these. Since the pictures are black on a white background, they are admirably adapted for photographing.

Mr. T. H. Johnston exhibited a series of Entozoa collected in New South Wales, including *Ascaris canis* and *Dipylidium caninum*, both from the cat and the dog; *Heterakis inflexa*, from a fowl's intestine; *H. papillosa*, from the cæca of a fowl, and of a turkey; *H. maculosa*, from a pigeon, this being the first record of its occurrence in Australia; *Spiroptera* sp., forming nodules or "kernels" in the muscles of cattle, the presence of this or a similar parasite having been already recorded by Dr. Cleland from cattle and camels in West Australia; *Cœnurus serialis*, the bladder-worm found in the muscles of the rabbit; and its adult form, *Tænia serialis*, from the intestine of the dog and the fox, this being the first mention of an entozoon from a fox in Australia; *Cysticercus pisiformis*, a bladder-worm which occurs on the rabbit's mesentery, and its adult form, *Tænia serrata*, from the dog's intestine; *Echinococcus polymorphus* from the rabbit. Of the last-named parasite, the hydatid form occurs frequently in sheep, cattle and pigs, and occasionally in horses and kangaroos in this State. Its final form is a very small cestode, *Tænia echinococcus*, which infests Australian dogs as well as the dingo, having been recorded from the latter host in West Australia and South Australia.

Mr. Henry Deane exhibited a number of interesting specimens collected recently by him during a visit of inspection of the more remote portion of the South Australian section of the route selected for the contemplated Transcontinental Railway, comprising fruiting branches of a scarlet-flowered dwarf Eucalypt (*E. pyriformis* Turcz.), remarkable for its enormous fruits, larger even than those of *E. macrocarpa* Hook.; seeds of three species of the N.O. *Santalaceæ* (*Fusanus acuminatus* and two species of *Santalum*); an example of a fairly large reddish scorpion (*Hormurus flavicruris* Rainbow) which is common in the sandhill country, and also of another scorpion (*Isometrus variatus* Thorell); and an ornament made from a pearly nautilus shell, found at a native camp at the sandhills. Also specimens of a mineral, epidote, from Pidinga, S.A., and of abnormal fruits of a palm (*Cocos plumosa*) from Hunter's Hill.

Mr. Cheel exhibited a series of fifteen interesting fungi, with the following notes thereon—ALBUGINACEÆ: *Albugo portulaceæ* DeBary; on leaves of *Portulaca oleracea*, Botanic Gardens, Sydney, and Penshurst (E. Cheel; March, 1908); Hawkesbury Agricultural College (C. T. Musson; February, 1909); not previously recorded for Australia MUCORACEÆ: *Pilobolus crystallinus* (Wiggers) Tode; on dung; Botanic Gardens, Sydney (E. Cheel; May, 1908); previously recorded only from Queensland. HELVELLACEÆ: *Morcella conica* Pers.; on the ground; Kirkham, near

Grenfell (Mina Jeffreys; September, 1906), and Coonabarabran (J. L. Boorman; September). USTILAGINEÆ: *Ustilago Readeri* McAlp. in litt.; host, *Danthonia penicillata*; Penshurst (E. Cheel; November, 1908). TILLETIINEAÆ: *Tilletia hordei* Körn.; host, *Hordeum murinum* Linn.; Coolac (P. Sullivan; November, 1908); Urana (C. R. Brett; January, 1906). PUCCINIACEÆ: *Puccinia cynodontis* Desm.; host, *Cynodon dactylon* (Pers.) L. C. Rich.; Botanic Gardens, Sydney (A. Grant; March, 1905), and Penshurst (E. Cheel; June, 1909); previously recorded only from Victoria (*vide* McAlp. in "Rusts of Australia," p.118, 1906). *Puccinia gnaphalii* (Speg.) P. Henn; host, *Gnaphalium purpureum* Linn.; Penshurst (E. Cheel; December, 1908); previously recorded only from Victoria, by McAlpine (*op. cit.*, p.158). *Puccinia lollii-avenœ* McAlp., = *P. coronata* Corda; host, *Avena sativa* Linn.,(oats); Penshurst(E. Cheel; May, 1908); previously recorded from Lismore, Murwillumbah, and Alstonville, by Dr. Cobb. POLYPORACEÆ: *Polystictus versicolor* Cke.; on decaying log; Wahroonga (J. Staer; June, 1909). *Polystictus xanthopus* (Fr.) Cke.; Atherton, near Cairns, Q.(E. Betche; 1901); between Cooktown and Cairns (W Seymour; 1908). *Strobilomyces pallescens* Cke. & Mass.; in old stumps; Bundanoon Gully (Miss M. Flockton; April, 1908); Cook's River (A. A. Hamilton; March, 1909). AGARICACEÆ: *Coprinus atramentarius* Fr.; on the ground, gregarious in habit; Botanic Gardens, Sydney (E. Cheel; July, 1907). *Coprinus extinctorius* Bull.; on manure-heaps; Botanic Gardens, Sydney (E Cheel; April, 1908) *Armillaria melleus* Vahl; on trunk of willow-tree (*Salix babylonica* Linn.); Botanic Gardens, Sydney (E. Cheel; June, 1909); an edible species, commonly known as the Honey-coloured Mushroom; parasitic on trees and shrubs, and one of the most destructive enemies of fruit-trees, etc. TUBERCULARIACEÆ: *Fusarium solani* Sacc.; host, potatoes (*Solanum tuberosum* Linn.); Grafton Experiment Farm (A. H. Haywood; December, 1908). Mr. Haywood reported that the potato-crop was very badly affected with a disease which, when examined, revealed numerous lunulate 2-5-septate conidia varying in measurement from 20-38 × 4-5μ.

These organisms agree in all essential points with those described under the name *F. solani* Sacc. To test the disease, two healthy tubers were planted in contact with portions of diseased ones; and the contact-plants "wilted" in thirty-seven and forty-four days respectively, whereas two others grown side by side, not brought into contact with the disease, continued to grow, and produced healthy tubers showing no sign of disease. The tubers were planted in large flower-pots. (See also Pethybridge & Bowers, Economic Proceedings of the Royal Dublin Society, i., pp.547-558, 1909).

Drs. Chapman and Petrie showed a series of tubes demonstrating the precipitin reaction with extracts of seeds. Rabbits had been immunized by the intraperitoneal injection of saline extracts of the seeds of *Acacia pycnantha*. The extracts were heated to 55°C. for 3 hours before injection. Some results are tabulated as follows.

N.O.	Species.	Extract heated.	Extract not heated.
Leguminosæ	*Acacia pycnantha*	ppt.	ppt.
,,	*A. penninervis*	ppt.	ppt.
,,	*A. neriifolia*	ppt.	ppt.
,,	*A. leptoclada*	ppt.	ppt.
,,	*A. accola*	ppt.	ppt.
,,	*A. spectabilis*	ppt.	ppt.
,,	*A. pendula*	ppt.	ppt.
,,	*Pisum sativum*	ppt.	ppt.
,,	*Phaseolus lunatus* (Lima Bean)	nil	nil
,,	*Vicia Faba*	nil	—
,,	*Medicago sativa*	nil	ppt.
Gramineæ	*Triticum vulgare*	nil	nil
,,	*Avena sativa*	nil	—
Myrtaceæ	*Eucalyptus sideroxylon*	nil	nil
Coniferæ	*Podocarpus elata*	nil	nil
Solanaceæ	*Solanum verbascifolium*	nil	nil
Epacrideæ	*Astroloma pinifolium*	nil	nil
Compositæ	*Humea elegans*	nil	nil
Proteaceæ	*Macadamia ternifolia*	nil	—

In the reactions tabulated, the antiserum was mixed with extracts of the seeds of various species. The extracts were divided into two parts, and one portion heated to 70°C. for one hour. Both extracts were tested. Suitable controls were made with natural serum of a rabbit, and with salt-solution as is customary in precipitin reactions. When a deposit occurred, whether large or small, the interaction was marked positive; but quantitative differences in the precipitates were not recorded in the table.

WEDNESDAY, AUGUST 25TH, 1909.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, August 25th, 1909.

Mr. T. Steel, F.C.S., F.L.S., Vice-President, in the Chair.

Mr. Egerton C. Grey, University of Sydney, was elected a Member of the Society.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 5 Vols., 59 Parts or Nos., 11 Bulletins, 1 Report, 6 Pamphlets, and 19 Maps, received from 48 Societies, &c., and one Individual, were laid upon the table.

NOTES AND EXHIBITS.

Mr. D. G. Stead exhibited a living specimen of the curious fish known as "Striated Serpent-head," *Ophiocephalus striatus* (Bloch), one of five specimens imported from Singapore a few days ago; and he read a note upon the extraordinary branchial structure and amphibious habits of the *Ophiocephali*. He also showed an example of a remarkable Brittle Star [Ophiuridea] (*Gorgonocephalus* sp.) from Coogee Beach, clasped naturally round the stem of a species of sponge; together with some small undetermined marine worms from one of his aquaria.

Mr. Froggatt, who had recently returned from a visit to the Solomon Islands, exhibited a large land-crab, *Cardisoma* sp., which lives in holes in the ground; and is a very great pest in gardens, by reason of its destructiveness to young plants. Specimens of a small, bright red snail which is common upon the foliage of plants in the forest-land; the bright red mucus sloughs off when the snails are killed. And a sample of a pigment used by the young people for painting their faces, when looking for a lover.

Mr. Cotton showed a sample of diamonds and diamond-associates from Copeton, about 15 miles south of Inverell, N.S.W. The former comprised twelve diamonds, total weight 4 carats, two being well developed octahedra, ten colourless and of first water, one straw-coloured, and one wine-coloured. The latter represented a concentrate of the diamond-bearing gravel, the minerals present being tourmaline, garnet, topaz, and quartz.

Mr. T. H. Johnston, of the Bureau of Microbiology, exhibited a series of potatoes showing various diseased conditions, viz., (1) Irish Blight, due to the fungus *Phytophthora infestans*, microscopic slides of which were shown; some of the tubers were from Tasmania, whilst others were from the Richmond River, N.S.W. (2) Dry Rot, due to the fungus *Fusarium solani* (New South Wales and Tasmania). (3) Wet Rot, due to *Bacillus solanacearum* (New South Wales). (4) Scab, due to the fungus *Oospora scabies* (New South Wales, Tasmania). Also Galls, due to the presence of nematode worms, *Tylenchus devastatrix* (New South Wales, Tasmania). He also exhibited a series of Entozoa, mainly from rats and mice, most of which, unless otherwise stated, had not been previously recorded as occurring in Australia, including: *Heterakis spumosa* and *Oxyuris obvelata*, both from the cæcum and rectum of *Mus decumanus*, *M. rattus*, *M. alexandrinus*, *M. musculus*; and *Trichodes crassicauda*, from the bladder of *Mus decumanus*: none of these three parasites had been previously recorded from any host in Australia. Apparently *Heterakis spumosa* had not been mentioned before as occurring in mice. *Moniezia trigonophora*, from the intestine of sheep and cattle, also now recorded for the first time as an Australian parasite; *Thysanosoma Giardi* (*Tænia ovilla*), collected and recorded by Dr. Cleland, from the intestine of West Australian lambs; *Cysticercus fasciolaris* from the liver of the four species of *Mus* mentioned above (New South Wales), *Mus alexandrinus* (West Australia, and *Mus rattus*(?)(Samoa); and *Tænia crassicollis*,(the adult form of the bladder-worm, *Cysticercus fasciolaris*) from the cat (New South Wales). He also noted that Prof. Gilruth, of Melbourne, had recently (Pastoralists' Review, 16th August, 1909) reported the occurrence of Sarcosporidia (*Sarcocystis* sp.) in the muscles of Tasmanian sheep and cattle(p.613), on the œsophagus (as *Balbiania gigantea*) of sheep in New Zealand(p.614), and in the tongue-muscles of a Victorian calf(p.614). The Professor believed this to be the first record of the occurrence of Sarcosporidia in Australian animals, but was apparently unaware of Dr. J. B. Cleland's record of having found *Balbiania* in West Australia in sheep imported from the eastern States. These sporozoon parasites are not unknown here, the following having been met with in New South Wales animals, in the course of the work of the Bureau—*Sarcocystis tenella*, in the muscles of a cow (Moruya district), and in the tongue (also infested by the fungus, *Actinomyces bovis*) of a calf; *S. tenella* (in its form known more commonly as *Balbiania gigantea*) on the œsophagus of sheep from various parts of the State; and *S. muris*, from the muscles of *Mus rattus* and *M. decumanus*(Sydney). Dr. Cleland had found (but had not recorded) *S. miescheriana* in some West Australian pigs.

Dr. Cleland said that since his paper " On Diurnal Variations in the Temperatures of Camels " was read, he had met with the following interesting record in 'Tracks of McKinlay across Australia,' (p.178; from the diary of John Davis; date December 20th, 1861; locality, near Cooper's Creek) showing that, under exceptional conditions of heat, camels may perspire visibly : " The horses quite in a lather; the camels even sweated, the first time they ever did so during the journey; . . . one of the finest bullocks died from the heat of the sun."

Mr. North sent for exhibition five adult skins of the yellow-collared Parrakeet (*Barnardius semitorquatus*), and a skin of Forster's Shearwater (*Puffinus gavia*), together with the following Note thereon—"The adult specimens of *Barnardius semitorquatus* show the variation in the plumage of this species. Quoy and

Gaimard in the 'Voyage de l'Astrolabe,' Gould in his folio edition of the 'Birds of Australia,' and Count Salvadori in the 'Catalogue of Birds in the British Museum' (Vol.xx.), all agree in describing the lower breast of *B. semitorquatus* as light green or yellowish-green. Dr. E. P. Ramsay in his 'Catalogue of Birds in the Australian Museum,' describes this part as deep yellow. Three adult specimens with a broad yellow band across the lower breast are exhibited; one, an adult male obtained by Mr. George Masters, at King George's Sound, W.A., in January, 1869; and an adult female and male obtained respectively by Mr. Tom Carter, at Broome Hill, South-western Australia, in January and February, 1907. The other adult males have the lower breast yellowish-green; one of them was procured by Mr. Carter, in the locality mentioned, in July, 1906; the other is the skin of a male which Mr. G. A Keartland of Melbourne, kept in confinement for ten years, this specimen being furthermore distinguished by its broader red frontal band. The skin of *Puffinus gavia* is that of an adult male picked up dead on Bondi Beach, by Mr. William Barnes, after an easterly gale in September, 1908. This extremely rare species in Australian waters is an inhabitant of the New Zealand seas, and was discovered in Queen Charlotte Sound during one of Cook's voyages. It was first recorded as an Australian species by Dr. P. L. Sclater (Proc. Zool. Soc. 1891) from a specimen presented to the British Museum by Professor Anderson Stuart, the bird having been picked up alive, after a storm, at Victoria Park, Newtown, Sydney, on August 2nd, 1891, by the late Mr. F. J. Bourne."

Mr. Fletcher showed a number of diptera, pronounced by Mr. Froggatt to be probably an undescribed species of *Ceratitis*, bred from fruits of *Loranthus pendulus* Sieb., forwarded from Perth, W.A., some time ago, by Dr. J. B. Cleland. The majority of the fruits sent were infested with the larvæ—one in each infected fruit—which had eaten out the seeds more or less completely by the time they were ready to pupate.

MOLLUSCA FROM THE HOPE ISLANDS, NORTH QUEENSLAND.

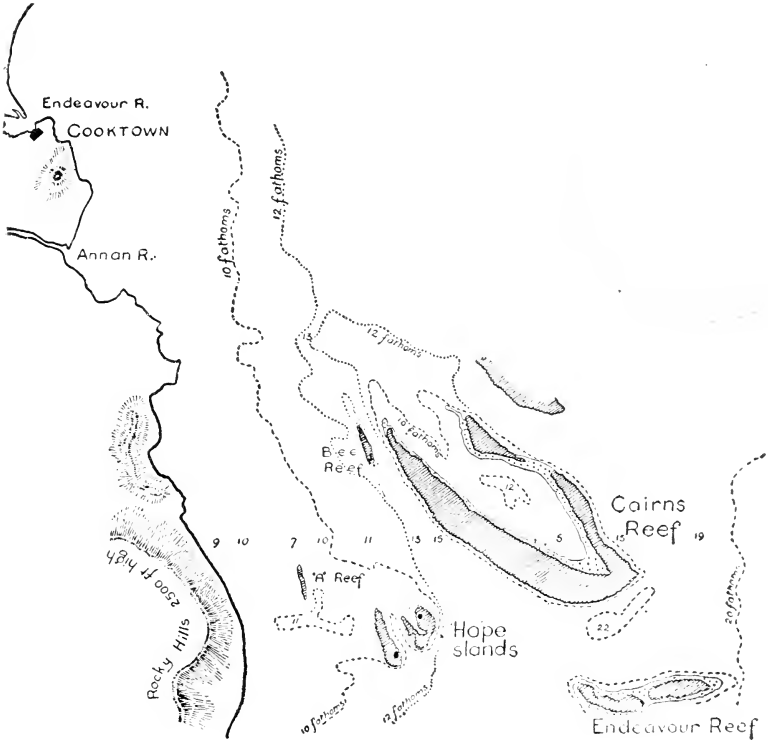
By C. Hedley, F.L.S.

(Plates xxxvi.-xliv.)

A few years ago, I was fortunate in securing the assistance of a party of friends to investigate the south end of the Queensland coral-reef-system. The results(These Proceedings,1906,p.453,etc.) were so gratifying, that I was encouraged to continue the study from another point of observation. Accordingly a party consisting of Mr. J. Gabriel, of Melbourne, Mr. T. Griffith Taylor, of the Sydney University, and Mr. A. R. McCulloch, of the Australian Museum, joined me in August, 1906, to examine the reefs about the Sixteenth Parallel.

At Cooktown we engaged the schooner "Lotus," under Capt. McCausland. We first visited the entrance of the Bloomfield River in Weary Bay, and thence sailed across to the Hope Islands. It was my intention to search the outer edge of the Barrier, but rough weather rendered this impossible, and we sought shelter in the lagoon of Cairns Reef, near the Hope Islands. By the courtesy of Mr. W. Howchin, I am permitted to explain the local geography by the following sketch-map, from the Report of the Australasian Association for the Advancement of Science, Vol.xi.

Aided by low spring-tides, we profitably employed our time dredging and shore-collecting. The mode of atoll-formation was studied by Mr. Taylor and myself. The evidence we gathered and the conclusions at which we arrived were presented to the Adelaide (1907) Meeting of the Association above referred to. From material collected by our party, Mr. F. Chapman made the



SKETCH MAP SHOWING THE GREAT BARRIER REEF AND ADJACENT COAST.

interesting discovery of the microspheric form of *Alveolina*.* Mr. Taylor contributed a humorous account of our travels to the University Journal.†

* Chapman, Journ. Roy. Micros. Soc. Lond. 1908, p.151.
† Taylor, Hermes, Vol.xiii., No.4, Aug. 23, 1907, pp.70-75.

MacGillivray collected on the Hope Islands, from which he records "a species of Quoyia."*

Fifty years afterwards Prof. Agassiz's party found here two new planarians.†

Immediately south of Cairns Reef lies the Endeavour Reef, upon which Captain Cook was wrecked. The only record of its fauna I have seen, is a note by Solander in the Catalogue of the Portland Museum, 1786, p.190, nr.4039 :—"A very perfect specimen of *Voluta pacifica Solandri*, brought by Capt. Cook, from the Reef off Endeavour River on the Coast of New Holland."‡ But since this species is confined to New Zealand, the record must be a mistake.

Many of the shells already reported from Mast Head Island of course recurred here. Others which we took at or around Hope Islands had previously been reported from North Queensland by the "Chevert," "Challenger," and other expeditions. To economise space, I have not referred to these, but have restricted attention to those either new to science, new to the region, of intricate synonymy, or otherwise noteworthy. Altogether we secured more than seven hundred species. As with the Mast Head collection, many novelties remain undescribed. In the present communication, one hundred species are discussed, half of which are introduced as new to science.

The collection described has been presented to the Australian Museum.

ARCA DAUTZENBERGI Lamy.

Arca dautzenbergi Lamy, Journ. de Conch. lv. 1907, p.232, Pl. iii., f.9,10,11.

This species, an addition to the Australian fauna, is represented by a few odd valves dredged in 8 fathoms, Weary Bay, off the

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* MacGillivray, Voy. Rattlesnake, i., 1852, p.104.

† Woodworth, Bull. Mus. Comp. Zool. xxxii. 1898, p.64.

‡ Chemnitz, Conch. Cab. xi. 1795, p.21.

mouth of the Bloomfield River. I had previously taken it, in 15 fathoms, off the Palm Islands.

Arca wendti Lamy.

A. wendti (Schmeltz) Lamy, Journ. de Conch. lv. 1907, p.45, Pl. i., f.11,12,13.

A considerable number of disassociated valves occurred of this small and recently described shell, which is new to Australia. It is conspicuous from the bright primrose-yellow blotches. The largest of my series is only 5 mm. long, half the size of the type.

Glycymeris pectunculus Linné.

Arca pectunculus Linné, Syst. Nat. x. 1758, p.695; *id.*, Hanley' Ips. Linn. Conch. 1855, p 98. *Pectunculus pectiniformis* Reeve, Conch. Icon. i. 1843, Pl. iii., f.11.

A few separate valves from the Hope Islands are the first notice of this species from Australia.

Pecten maldivensis Smith.

Pecten maldivensis Smith, Fauna Maldive and Laccadive Archipel., ii. 1904, p.622, Pl.xxxvi., f.19,20.

I am indebted to Mr. C. J. Gabriel for identifying Hope Island specimens with the type in the British Museum. The species is new to the Australian fauna.

Chlamys corymbiatus, n.sp.

(Plate xxxvi., figs.1-4.)

A species of the Æquipecten group, small, solid, inflated, almost equilateral, scarcely gaping, left valve shallower. Colour ochraceous mottled with opaque white and chestnut-brown. Sculpture: eighteen prominent ribs parted by deep grooves, the latter densely latticed by thin produced lamellæ. Each rib is tripartite and decorated by small epidermal blisters which resolve into a median, lateral and connecting series. The median and lateral blisters assume the form of imbricating scales, the intermediate ones are like berries. For a space at each side the ribs are absent. Right anterior auricle ribbed by four spaced nodose riblets, the posterior rayed by half a dozen tuberculate threads. Ctenidium of five teeth. Interior smooth with plicate margins. Height 20; length 20; depth of single valve 7 mm.

Mr. A. Bavay, who kindly examined this species for me, con siders that it is a new species related to *C. nux* Reeve. *C. smithi* Sowerby, is also akin. It was an abundant species off the Hope Islands, and seems generally distributed in tropical Queensland, for I took it, in 15 fathoms, off the Palm Islands, and, in 10 fathoms, off Mapoon. Mr. A. U. Henn collected it in anchor-mud from 10½ fathoms off Cape Sidmouth.

MODIOLA AURICULATA Krauss.

Modiola auriculata Krauss, Sudafrik. Moll. 1848, p.20, Pl. ii., f.4; *id.*, Smith, Zool. Coll. Alert, 1884, p.508; *id.*, Jukes Browne, Proc. Malacol. Soc. vi. 1905, p.225; Lamy, Bull. Mus. d'Hist. Nat. Paris, 1906, p.311.

This mussel has not been before noted as Australian. Some living specimens were gathered on the reef.

CUNA PRÆCALVA, n.sp.

(Plate xxxvi., figs.5-8.)

Shell small, solid, rather inflated, equilateral, triangular-cordate. Colour white. The dorsal margins straight, meeting in a right angle, the ventral margin rounded. Sculpture: the umbonal region is peculiarly smooth and flattened. Within it the radial ribs are merely indicated, but without they assume sudden prominence, and in each interstice another radial arises. At the margin these ribs amount to about eighteen; they are parted by rather broader, deep, steep-sided grooves, and on their crests are spaced imbricating scales. The inner margin of the valve is denticulated to correspond with the external sculpture. The right margin develops a pseudo-lateral tooth, fitting against a distant lateral tubercle within the left socket. The socket itself is transversely striated. Height 1·95; length 2·05; depth of single valve 0·75 mm.

The flattened umbo is a good recognition-mark for this species, which occurred abundantly in 5-8 fathoms off the Hope Islands. I took it also in 15 fathoms, off the Palm Islands.

Cuna capillacea, n.sp.

(Plate xxxvi., figs.9-10.)

Shell small, solid, rather compressed, triangular-cordate. Colour buff-pink. Sculpture: from twelve to fourteen ribs proceed from the prodissoconch regularly to the ventral margin; they are low and rounded, tending to split into a bundle of riblets; their crests are surmounted by reverse imbricating tubercles, which medially are deficient or slightly developed, but on the lateral ribs project as prominent scales. Intervening furrows are wide and flat-bottomed. A concentric sculpture of fine hairlines overruns the whole shell, but is best developed in the furrows. Height 1·9; length 2·05; depth of single valve 0·75 mm.

Numerous specimens, in 5 to 8 fathoms, off the Hope Islands. I previously dredged a few, in 17-20 fathoms, off Mast Head Island.

This species closely resembles *C. præcalva* in size and shape, the colour and comparative smoothness of *C. capillacea* being the most obvious features for separation.

Another member of this family, *Crassatellitidæ*, not yet recorded from Queensland, is *Hemidonax donaciforme* Schroeter,* which I have traced as far north as Port Curtis.

Cardita semiorbiculata Linné.

Chama semiorbiculata Linné, Syst. Nat. x. 1758, p.691; Hanley, Ips. Linn. Conch. 1855, p.87. *Cardita phrenitica* Lamarck,

**Cardium donaciforme* Schroeter, Einl. Conch. iii. 1786, p.68, pl.vii., f.14; *C. donaceum* Spengler, Skr. nat. Selsk., v.(1) 1799, p.37; *id.*, Morch, Malak. Blätt. xvi., 1870, p.120. *Hemicardium donaciforme* Tryon, Am. Journ. Conch. vii. 1872, p. 271; Dall, Trans. Wagn. Free Inst. iii. 1900, p.963. *Donax cardioides* Pritchard & Gatliff, Proc. Roy. Soc. Vict. (2), xvi. 1903, p. 119.

Anim. s. vert. vi. 1819, p.24. *Cardita semiorbiculata* Reeve, Conch. Icon. i., *Cardita*, 1843, Pl. iii., sp.10.

A living specimen was taken on the reef at low-water, and a separate valve was dredged in 5-10 fathoms. It has not been seen before from Queensland, and, but for Lamarck's remark, "Habite . . . . la Nouvelle Hollande" in the above citation, I should have claimed it as new for Australia. This is the type of Bolten's subgenus *Beguina*.

CODAKIA REEVEI Deshayes.

Lucina reevei Deshayes, Moll. de Réunion, 1863, p.19, Pl. iii., f.8,9.

On the beach at Hope Island I gathered some specimens which answer fairly to Deshayes' account. They differ by having rather fewer and stronger ribs, and measure 18 mm. as against 25 mm. of the type. The species has not before been noticed from Australia.

PHACOIDES EUCOSMIA Dall.

(Plate xxxvii., fig.16.)

Parvilucina eucosmia Dall, Proc. U.S. Nat. Museum, xxiii., 1901, p.806, new name for *Lucina pisum* Reeve, Conch. Icon. vi., Aug., 1850, *Lucina*, Pl. xi., fig.66*a,b*; *id.*, Smith, Chall. Rep. Zool. xiii. 1885, p.181 (not *Lucina pisum* Sowerby, Geol. Trans., 2nd ser., iv. 1837, p.341, Pl. xvi., f.14; nor *L. pisum* D'Orbigny, Pal. France, Terr. Cret. iii. 1841, Pl.281, f.3-5; nor *L. pisum* Philippi, Abbild. Besch. iii., April, 1850, p.105, Pl. ii., f.9).

This species did not occur in the Hope Island collection. It is introduced for comparison with other species, and to aid in the perplexities of its nomenclature. The individual figured is 5 mm. long. I dredged it in 5 fathoms, soft black mud, in Van Diemen's Inlet, Gulf of Carpentaria, where the species was abundant. Other localities in the same Gulf, where I met with it, are Mornington and Forsyth Islands, and off the mouth of the Batavia, Horsey, and Norman Rivers. I have not yet found it on the Pacific Coast.

PHACOIDES RUGOSUS, *nom.mut.*

(Plate xxxvii., fig.17.)

Lucina (*Codakia*) *seminula* Smith, Chall. Rep. Zool. xiii. 1885, p 180, Pl. xiii., f.5,5*a*:(not *L. seminulum* Deshayes, Anim. s. vert. foss. de Paris, i. 1858, p.673, Pl. xliv., f.5-8; nor *L. seminula* Gould, Proc. Bost. Soc. Nat. Hist. viii. 1861, p.36).

Dr. W. H. Dall, in whose official custody lies the type of *L. seminula* Gould, states* that it is the same as *L. pisum* Reeve. Further, the name itself is preoccupied. It follows that the shell described and figured in the Voyage of the "Challenger" requires a name, which is here supplied. The height of the individual figured is 2·2; length 2·35, and depth of single valve 1·05 mm. Specimens east of Torres Straits seem less densely concentrically ribbed than those from the west. I have taken it with the preceding species in Van Diemen's Inlet, in 15 fathoms, off the Palm Islands, and at Barney Point, Port Curtis. The species is abundant off the Hope Islands.

PHACOIDES SPERABILIS, n.sp.

(Plate xxxvii., fig.18.)

Shell small, solid, inequilateral, rather inflated and oblique. Colour white. Sculpture: the radials are broad and low, about fourteen in number; sometimes, as in the shell drawn, they run their course unchanged to the margin, in other individuals the ribs multiply by fission or intercalation. The concentric sculpture consists of thin, narrow but erect lamellæ, which overrun both ribs and interstices, usually faint medially but rising into prominence at the sides. Sometimes they are crowded, and sometimes spaced, and may vary in number from fourteen to over twenty. Inner margin of valve finely denticulate. Height 3·15; length 3·25; depth of single valve 1·25 mm.

The variability of both radial and concentric sculpture changes the appearance of this species. The concentric sculpture is,

* Dall, Proc. U.S. Nat. Museum, xxiii., 1901, p.816.

however, always feebler than in related forms. Off the Hope Islands, in 5-10 fathoms, it was abundant.

MYRTÆA DESIDERATA Smith.

Lucina (*Loripes*) *desiderata* Smith, Chall. Zool. Rep. xiii. 1885, p.185, Pl. xiii., f.10.

Numerous valves, both double and single, were dredged in 5-10 fathoms. This is the first note of the species east of Torres Strait.

SPORTELLA JUBATA, n.sp.

(Plate xxxvii., figs.22-23.)

Shell of moderate size, solid, inflated, rather glossy, inequilateral, subrhomboidal. Colour white. Sculpture: extremely fine radiating threads, which increase by intercalation, the median and lateral threads diverging on either side at an acute angle. A few spaced growth-lines intersect the radials. Length 8·5; height 6; depth of single valve 2 mm.

A couple of odd valves, from 5 to 10 fathoms, represent this species.

SPORTELLA SPERABILIS, n.sp.

(Plate xxxvi., figs.13-15.)

Shell small, rhomboidal, compressed, opaque, solid for the size. Colour white. Prodissoconch distinct, smooth. Sculpture: fine regular radiating riblets commence at the prodissoconch-suture as slender threads, diverge and strengthen with growth, a few fork. Those ventrally directed attain the margin, but the lateral ones vanish before reaching the edge. Inner ventral margin denticulated by the sculpture. Length 2; height 2; depth of singel valve 0·5 mm.

A few separate valves occurred. In the selection of the genus, not hitherto recorded from Australia, I have been guided by the apparent relation of my shell to *S. obolus* Dall.*

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* Trans. Wagner Inst. Sci. iii. 1900, p.1126, Pl. 44, f.18.

ROCHEFORTIA VIASTELLATA n.sp.

(Plate xxxvi., figs.11-12.)

Shell thin, long and narrow, a little inequilateral, dorsal and ventral margins straight and parallel, ends rounded. Colour white. Sculpture; regular concentric threads cut into grains by curved obliquely diverging striæ. In the middle of the disk the diverging lines become obsolete. In general appearance the three intersecting curves resemble the pattern called "engine-turned." Length 4·05; height 1·9; depth of single valve 0·6 mm.

The subcylindrical form and intricate sculpture well distinguish this form. There is but a single valve, from 5-10 fathoms.

GALEOMMA DENTICULATA Deshayes.

Galeomma denticulata Deshayes, Moll. de Réunion, 1863, p.19, Pl. xxx., f.1-3.

A single valve, smaller and proportionately higher than the figure, is assigned to this species, which has not before appeared in Australia.

CARDIUM LOBULATUM Deshayes.

Cardium lobulatum Deshayes, Proc. Zool. Soc. 1854(1855), p.332; *id.*, Smith, Fauna Maldive, Lacc. Arch. ii. 1906, p.625.

(Plate xxxvii., figs.19-21.)

Mr. C. J. Gabriel identified this, by comparison with the type in the British Museum. A number of separate valves occurred to us in the Cairns lagoon. That now figured is 32 mm. high, 26 mm. long, and 18 mm. deep. Externally cream mottled with brown, internally flesh-pink.

As neither figures nor measurements were given to assist in the identification, the species has remained practically unknown. Tryon* and Hidalgo† have complained of the insufficiency of published data. The worst work, probably the only bad work, Deshayes ever did was that published in London. The deliberate omission of measurements was probably due to the unhappy influence of A. Adams.

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* Amer. Journ. Conch. vii. 1872, p.273.

† Mem. R. Acad. Cien. Madrid, xxi. 1903, p.342.

Isocardia moltkiana Gmelin.

Chama moltkiana Gmelin, Syst. Nat. xiii., 1791, p.3303.

A single broken valve came from the Cairns lagoon; some years previously, I took a similar fragment, in 15 fathoms, off the Palm Islands.

I note that Hidalgo* ascribes this name to Spengler in 1783. This reference is inaccessible to me, but since Sherborn omits it from the Index Animalium, I conclude that Spengler's name was not legitimate.

Dosinia exasperata Philippi.

Cytherea (Artemis) exasperata Philippi, Abbild. und Besch. Conch. iii. 1847, p.36, Pl. viii., f.4; *id.*, Zeit. für Malak. vi. 1849, p.41.

A single valve, dredged in 8 fathoms, in Weary Bay, off the mouth of the Bloomfield River, extends the range of this species to Australia.

Gafrarium catillus, n.sp.

(Plate xxxvii., figs.24-27.)

Shell small, lenticular, margin subcircular, slightly produced anteriorly and angled dorsally. Colour dull white, rayed with brown along the sculpture-parting, and the anterior third. Interior white, purple or brown. Sculpture: fine radiating riblets, about forty on the posterior side and a few more on the anterior, which diverge at an acute angle from an oblique parting. The riblets proceeding from the parting curve outwards and broaden, while additional riblets may be intercalated in the interstices. The riblets are broken and beaded by fine concentric growth-lines, while their interstices are roughened by a secondary microscopic vermiculate sculpture. Height 14; length 16; depth of single valve 3 mm.

Plentiful, in 5-10 fathoms, off the Hope Islands. The nearest Australian ally is *G. navigatum* Hedley, from the Capricorn

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* Mem. R. Acad. Cien. Madrid, xxi. 1903, p.363.

Islands, which is smaller and more coarsely sculptured. Judging from Roemer's figure, *G. catillus* is more compressed, oblique, and finer sculptured than *G. æquivoca* Chemnitz.

Chione lionota Smith.

Venus (Chione) lionota Smith, Chall. Rep. Zool. xiii. 1885, p.126, Pl. iii., f.7. *Venus (Chione) infans* Smith, *op. cit.* p.128, Pl. iii., f.3.

This species, dredged in 5-10 fathoms, was one of the commonest shells. I found it equally abundant, in 15 fathoms, off the Palm Islands. Considerable variation in sculpture occurs. *C. infans* is a form in which extra radials are intercalated at an early stage.

Chione scandularis, n.sp.

(Plate xxxviii., figs.28-29.)

Shell solid, ovately triangular, moderately inflated. Anterior margin straight, posterior a little convex, ventral rounded but slightly sinuate posteriorly. Colour dull white or pale yellow, irregularly rayed or spotted with rusty brown. Sculpture: about fifteen spaced concentric lamellæ, which on a posterior ray become more elevate and almost imbricate, elsewhere thick and low, cut into beads by the passage of crowded radiating costellæ which increase by splitting to about thirty. Lunule and escutcheon sharply defined, crossed by growth-lines only. Margin of the valve within everywhere finely denticulate. Length 15; height 11; depth of single valve 4 mm.

Among Australian species it may be compared with *C. scabra* Hanley, from which its size and coarse sculpture separate it. It was abundant off the Hope Islands. I had previously taken it, in 15 fathoms, off the Palm Islands; and Mr. A. U. Henn obtained it from anchor-mud, in 10½ fathoms, off Cape Sidmouth.

Tellina etesiaca, n.sp.

(Plate xxxviii., figs. 30-32.)

Shell minute, thin, diaphanous, glossy, triangular, compressed. Posterior and dorsal margins straight, meeting in a right angle.

Anteriorly rounded, posteriorly subrostrate, with a slight fold. Umbo prominent. Under high magnification a concentric sculpture appears of broken irregular lamellæ and grains which do not extend to the posterior side. Length 2·14; height 1·95; depth of single valve 0·6 mm.

The large number of individuals, approximately equal in size, indicate that the form described is adult. In which case it is the smallest Australian member of its genus.

A conspicuous member of the family, not yet reported from Queensland, is *Macoma candida* Lamarck,* which I have identified from Keppel Bay, Townsville, Cardwell, and Forsyth Island.

TELLINA PHILIPPII Philippi.

Tellina philippii Anton, in Philippi, Abbild. & Besch. Conch. i. p.126, Tellina, Pl.ii., f. 8, June 1844; *id.*, *op. cit.*, ii. 1846, p.94, addendum: *Tellina rastellum* Hanley, Proc. Zool. Soc. 1844, p.59 (Sept. 1844); *id.*, Thes. Conch. i. 1846, p.225, Pl.lxiv., f.2, Pl.lxv., f.242; *id.*, Recent Shells, 1856, p.347, suppl. Pl.14, f.14; *id.*, Bertin, Nouv. Arch. Mus. (2) i. 1878, p.240.

Dating the species from publication, as we must under modern rules, the use of *T. philippii* is obligatory. The older writers, who reckoned from the spoken announcement, considered that *T. rastellum* had priority. The shell, here represented by a single perfect specimen from the Hope Island beach, is new to Australia.

TELLINA REMIES Linné.

Tellina remies Linné, Syst. Nat. x. 1758, p.676; *id.*, Hanley, Ips. Linn. Conch. 1855, p.41; *id.*, Bertin, Nouv. Arch. Mus. (2), i. 1878, p.318.; *id.*, Dall, Trans. Wagn. Inst. iii. pt.5, 1900, p.1012.

Several specimens from the beach at Hope Islands. I had previously taken it on the Palm Islands; but, though of usual occurrence, this large species has not been previously noted from Queensland. The synonymous *T. sulcata* was reported by its author† from Shark Bay, W.A., and erroneously from Port Jackson.

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* Bertin, Nouv. Arch. Mus. (2), i. 1878, p.342.

† Lamarck, Anim. s. vert. v. 1818, p.528.

Arcopagia angulata Linné.

Tellina angulata Linné, Syst. Nat. xii. 1767, p.1116; Hanley, Ips. Linn. Conch. 1855, p.33. *Arcopagia plicata* Valenc., Bertin, Nouv. Arch. Mus. (2), i. 1878, p.317.

A single valve, from the beach of Hope Island, adds this species to the Australian list. Confusion has occurred between this and another, usually known as *Tellina angulata*, Linné,(as Bertin, *op. cit.* p.330). The latter has been recently distinguished as *T. lamyi* Dautz. & Fischer.*

Arcopagia lingua felis Linné.

Tellina lingua felis Linné, Syst. Nat. x. 1758, p.674; *id.*,Menke, Moll. Nov. Holl. Spm. 1843, p.41; *id.*, Hanley, Thes. Conch. i. 1846, p.266, Pl.lxiv., f.236.

I had already taken this species at Dunk Island, and at Forsyth Island in the Gulf of Carpentaria; but an example from Hope Island leads me to note that it has not been recorded from Queensland, though not uncommon there.

Arcopagia carnicolor Hanley.

Tellina incarnata Hanley (non Linn.), Proc. Zool. Soc. 1844, p.68. *Tellina carnicolor* Hanley, Thes. Conch. i. 1846, p.263, Pl.lvi.,f.15; *id.*, Smith, Fauna Maldive, Lacc. Arch. ii.1903,p.627. *Arcopagia carnicolor* Bertin, Nouv. Arch. (2) i. 1878, p.322; *id.*, Hidalgo, Mem. R. Acad. Cien. Madrid, xxi. 1903, p.154. *Tellina strangei* Deshayes, Proc.Zool.Soc.1854(1855),p.362; *id.*, Hutton, Man. N. Z. Moll. 1880, p.144. *Tellina corbis* Sowerby, Conch. Icon. xvii, 1867, Pl.xxiv., f.127.

A perfect, though dead shell, from the Hope Island beach seems to be the first representative of the species in Australian waters. The ascription of *T. strangei* to New Zealand is an error, as pointed out by Suter.†

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* Dautzenberg & Fischer, Journ. de Conch. liv., 1906, p.224.

† Suter, Proc. Malacol. Soc. vii. 1907, p.213.

ARCOPAGIA DAPSILIS, n.sp.

(Plate xxxviii., fig.33.)

Shell small but comparatively solid, oblong-equilateral, the dorsal margins rather straight, meeting at an obtuse angle, where the umbo projects suddenly and rather obliquely; anterior, ventral, and posterior margins rounded. Colour white. The whole surface is minutely reticulated by the intersection of about one hundred fine radial threads, with concentric threads of equal size and space. In addition, there are wide elevated concentric folds, varying from none to a dozen, and which may be evenly distributed over the disk or confined to the first third or so. These coarse folds are traversed without interruption by the finer sculpture. I was unable to detect the pallial scar. Length 2·9; height 2·3; depth of single valve 0·55 mm.

This is the smallest Australian *Arcopagia*; its shape distinguishes it from such small forms as *A. elegantissima* Smith, *A. tenuilamellata* Smith, or *A. fabrefacta* Pilsbry. It seems to be widely distributed in Queensland, for not only did we take it plentifully, in 5-8 fathoms, off the Hope Islands, but I dredged it previously, in 15 fathoms, off the Palm Islands, and, in 17-20 fathoms, off Mast Head Island. Mr. H. L. Kesteven also found it on the beach at Caloundra.

SEMELE ISOCELES, n.sp.

(Plate xxxviii., figs.34-36.)

Shell small, thin, translucent, triangular equilateral, inequivalve, rather inflated. Ventral margin rounded, posterior and anterior margins straight, except that the right anterior margin is more curved. Colour white. Sculpture: about twenty delicate erect concentric lamellæ, irregularly spaced, undeveloped towards the umbo, crowded towards the ventral margin. Length 3·25; height 2·9; depth of single valve 1·1 mm.

This species appeared in abundance. Mr. A. U. Henn also found it in blue mud, adhering to a ship's anchor, in 10½ fathoms, off Bow Reef, near Cape Sidmouth, Queensland. Its nearest

Australian ally is *S. infans* Smith, which occurred with it, in 5-10 fathoms, off the Hope Islands. *S. isosceles* is smaller, more inflated, more solid, more triangular, and is especially distinguished by its concentric sculpture.

THEORA NASUTA, n.sp.

(Plate xxxviii., figs.37-39.)

Shell small, ovate-acuminate, a little inflated, thin and translucent. Rounded on the ventral and anterior margins, posteriorly produced and angled. Colour white. Surface smooth. Length 4·65; height 3·5; depth of single valve 1·25 mm.

Compared with *Theora fragilis* A Adams, this is a smaller shell, proportionately shorter and more sharply beaked. It was a common species at the scene of our dredgings, and I had previously found it as abundant, in 15 fathoms, off the Palm Islands.

DAVILA PLANA Hanley.

Mesodesma planum Hanley, Proc. Zool. Soc. 1843, p.102; *id.*, Reeve, Conch. Icon. viii. 1854, Mesodesma, Pl. iii., f 16; *id.*, Hidalgo, Mem. R. Acad. Cien. Madrid, ii. 1903, p.65. *Davila plana* Dall, Trans. Wagn. Inst. iii. pt.4, 1898, p.913.

This gregarious species lives buried in wet sand at the foot of the Hope Island beach. It seems to have escaped attention as an Australian native. I have gathered it at Dunk, Green, and Palm Islands.

GASTROCHÆNA GIGANTEA Deshayes.

Fistulana gigantea Desh., Encycl. Méth., Vers, ii. 1830, p.142. *Gastrochæna gigantea* Desh., Trait. elém. Conchyl. i. 1843, p.34, Pl.ii., f.6,7,8; *id.*, Lamy, Bull. Mus. d'Hist. Nat. xii. 1907, p.207.

Under the name of *G. lamellosa* Desh., this species was added to our fauna by the Challenger Expedition. Dr. Lamy shows that both names, *gigantea* and *lamellosa*, refer to the same shell. In the case of *Cardium lobulatum*, the blighting influence of the Cumingian clique upon Deshayes has already been noticed. On all the reefs of the Great Barrier this is a common shell.

FISTULANA MUMIA Spengler.

Gastrochæna mumia Spengler, Nye Saml. K. Danske Skrifter, ii. 1783, p.179; *id.*, Tryon, Amer. Journ. Conch. iii. 1868, suppl., p.11. *Fistulana mumia* Smith, Proc. Malacol. Soc. vi. 1905, p.185.

A single specimen, from 5-10 fathoms, admits this stranger to the Australian fauna.

SUBEMARGINULA CLATHRATA Adams & Reeve

Patella tricarinata Born, Index Mus. Caes. Vind. 1778, p.440; *id.*, Testac. Mus. Caes. Vind. 1780, p.423, Pl.xviii. f.6; *id.*, Brauer, Sitzb. k. Akad. Wiss. lxxvii. 1878, p.73; not of Linné, 1767. (?)*Emarginula panhi* Quoy & Gaimard, Voy. Astrolabe, Zool. iii. 1834, p.327, Pl.68, f. 7-8. *E. clathrata* A. Adams & Reeve, Voy. Samarang, Moll. 1850, p.69, Pl.xi., f.6.

Under Born's name, I added this to the Australian fauna through a specimen from Mast Head Island. On again finding it from the Hope Islands, I remark that Born never proposed his *Patella tricarinata* as a new species, so that when it is accepted that he did not treat of the Linnean *P. tricarinata*, his name has no standing in literature. The Astrolabe figure ascribed to this species is not a good one, and has indeed been referred elsewhere by Deshayes.* I would take advantage of the excuse that "panhi" is not Latin, to reject the name. We thus arrive at the name proposed by Adams and Reeve, which is supported by an excellent figure.

LIOTIA TRIBULATIONIS, n.sp.

(Plate xxxix., figs.40-42.)

Shell minute, solid, depressed-turbinate. Colour cream. Whorls four and one-half, separated by a canaliculate suture. Sculpture: first two and one-half whorls smooth, remainder with five prominent spiral beaded cords, one a crown to the shell, another the umbilical edge, another running along the periphery,

* Anim. s. vert., (2) vii. 1836, p.584.

and others equidistant between these. The broad and shallow intervals are crossed by threads which rise in scale-tubercles on each cord, at the rate of about 35 knots to a cord, these radials penetrating the umbilicus. The latter is broad and funnel-shaped. Aperture subcircular, oblique, outer lip thickened. Height 0·9; major diam. 2·85; minor diam. 1·4 mm.

A few specimens, from 5-10 fathoms, Hope Islands. It also occurred to me, in 15 fathoms, off the Palm Islands. The novelty is nearest related to *L. venusta* Hedley,* but is far smaller, though proportionately higher and narrower, and more ornately sculptured. More remote are *L. acidalia* Melvill & Standen, and *L. philtata* Hedley.

LIOTIA ANXIA, n.sp.

(Plate xxxix., figs.43-45.)

Shell minute, depressed, turbinate, widely umbilicate. Colour pale buff. Whorls three, rapidly increasing and loosely coiled, the final half-whorl descending and departing from the remainder. Sculpture: fine radial threads traverse the whole shell, about sixty of these being on the last whorl, their interstices closely latticed by rather finer spirals. Aperture free, circular, simple. Umbilicus broad and deep. Height 0·7; maj. diam. 1·1; minor diam. 0·85 mm.

A few specimens, from 5-10 fathoms, Hope Island, and 8 fathoms, Weary Bay. The novelty is related to *L. disjuncta* Hedley,† which differs in the sculpture.

CYCLOSTREMA ANXIUM, n.sp.

(Plate xxxix., figs.46 48.)

Shell small, rather thin, glossy, discoidal, carinate. Colour dull white, whorls four, including a small elevate protoconch of a whorl and one-half, the last rapidly increasing. Suture envelop-

* These Proceedings, 1901, xxvi. p. 17, Pl.ii., f.1-3.

† Hedley, Mem. Austr. Mus. iv. 1903, p.336, f.66.

ing the keel of preceding whorl. Keel broad, projecting a fold beneath. Sculpture: above are about sixteen equidistant fine pitted grooves, and on the base half as many. Base rounded. Umbilicus broad and deep, angled at the margin, about one-quarter of the shell's diameter. Aperture entire, oblique, ovate, lip a little reflected below. Height 0·9; maj. diam 2·1; minor diam. 1·55 mm.

Two specimens, from 8 fathoms, off the Bloomfield entrance, in Weary Bay.

CYCLOSTREMA TORRIDUM, n.sp.

(Plate xl., figs.49-51.)

Shell small, depressed, turbinate, perforate, thin, subtranslucent. Colour white. Whorls three, rounded, loosely coiled and rapidly increasing. Surface smooth and very glossy. Aperture subcircular, outer lip simple, inner lip expanded and bent towards the axis. Base rounded, umbilicus very narrow. Height 1·1; major diam. 1·2; minor diam. 0·9.

Numerous specimens, from 5-10 fathoms, off the Hope Islands. Allied to the southern *C. porcellanum* Tate & May, which is more elevated and a little larger.

NERITINA OUALANIENSIS Lesson.

N. oualaniensis Lesson, Zool. Coquille, ii. 1830, p.379; *N. ualanensis* von Martens, Conch. Cab. 1879, p.193, Pl.xx.: *N. mertoniana* Brazier, these Proceedings, ii. 1877, p.21.

This species is abundant on the mud-flats at the entrance of the Bloomfield River. The beautiful colour-variety, termed *frondicincta* by von Martens, is predominant. Though Brazier had already recorded it under Recluz' synonym from the Palm Islands, I had overlooked it in compiling my catalogue of the mollusca of Queensland.*

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* Report Australasian Association Advancement of Science. Vol. xii. Brisbane, 1909.

OBTORTIO VULNERATA, n.sp.

(Plate xl., fig.52.)

Shell elongate-conical. Colour dull white, a purple dash on the columella, apex tinged with brown. Whorls nine, inflated at the periphery, contracted at the suture. Sculpture: a varix frequently occurs on the back of the last whorl, and another on the penultimate whorl. Radials perpendicular, about fifteen, prominent at the periphery, declining towards the suture, on the final whorl tending to disappear. Spirals about eight cords on the last whorl, parted by broad and shallow interstices, on the earlier whorls about five, of which two or three on the periphery are most prominent. Two apical whorls smooth. Aperture oval, subchannelled anteriorly, outer lip simple, columellar lip thickened and reflected. Length 4; breadth 1·25 mm.

Abundant, in 5-10 fathoms, off the Hope Islands. This is a larger, more solid, and more coarsely sculptured shell than *O. fulva* Watson. The stain on the columella seems a useful recognition-mark.

On further examination I find that the protoconch of this genus is not heterostrophe, as I supposed at first. I would, therefore, withdraw it from the *Pyramidellidæ*, and transfer it to the *Rissoidæ*. *Bittium diplax* Watson,* appears to be another member of the genus.

The descriptions and figures of *Fenella* suggest to me that this genus of A. Adams might embrace the species I include in *Obtortio*, but I have rejected that genus because Watson and Melvill, who had the advantage of examining actual specimens, did not employ it.

CERITHIUM NODULOSUM Bruguière.

Cerithium nodulosum Bruguière, Ency. Méth., Vers, ii. 1792, p.478; *id.*, Brazier, Proc. Linn. Soc. N. S. Wales, i. 1877, p.313; *id.*, Dall, Proc. Philad. Acad. Nat. Sci. 1907, p.366. *Cerithium*

* Watson, Chall. Rep. Zool. xv. 1886, p.556, pl.xxxviii., f.4.

curvirostra Perry, General Conchology, 1811, Pl. xxxv., f.2. *Mathilda eurytima* Melvill & Standen, Journ. of Conch. viii. 1896, p.310, Pl.xi., f.73, and Journ. Linn. Soc., Zool., xxvii. 1899, p.170. *Contumax decollatus* Hedley, Mem. Austr. Mus. iii. 1899, p.436, f.25.

A series of growth-stages shows that the shells described by Melvill & Standen and myself, as above, are merely the young and decollate shell of this *Cerithium*. It has already been reported from this coast by Brazier, who saw it at Darnley Island. It is a characteristic associate of reef-corals.

Triphora tribulationis, n.sp.

(Plate xl., figs.53-54.)

Shell small, narrowly conical, acuminate. Colour white, irregularly splashed with rust. Whorls nine and a four-whorled protoconch. Sutures deep. On the spire-whorls two rows of beads, the upper the larger, within the row united by a broad band, each bead linked to its fellow in the opposite row by a fine radial thread, thus enclosing a deep square interstice. On the antepenultimate a spiral thread arises between the bead-rows and increases slowly to a full bead-row on the last whorl. Finally there are six bead-rows, the basal three small. A secondary sculpture of fine spiral threads is sometimes visible between the beads. Protoconch: first whorl round and smooth, remainder keeled and crossed by fine radial threads. Aperture subcircular, deeply notched above, canal much recurved, projecting as a spur, closed at the base. Length 4·25; breadth 1·25 mm.

Several specimens, off the Hope Islands. I found it also on the reef at Mast Head Island.

Cerithiopsis pinea, n.sp.

(Plate xl., fig.55.)

Shell small, solid, the shape of a pine cone. Colour purple with cream beads. Whorls six, with a many-whorled subulate protoconch [mutilated in the specimen seen]. Sculpture: prominent, rather elongate gemmules, set in two rows of about nineteen beads to a whorl, spirally strung on a band of half their height, and within the whorl linked from row to row, thus enclosing deep meshes in the interstices. Upon the contracted base are two additional and successively diminishing bead-rows. Aperture small, subquadrate. Length (with broken apex) 2·35; breadth 1·25 mm.

A few imperfect specimens from 5-10 fathoms, off the Hope Islands.

CERITHIOPSIS TELEGRAPHICA, n.sp.

(Plate xl., fig 56.)

Shell small, solid, elongate-ovate. Colour chestnut on the last whorls, fading to cream on the earlier, and to white on the protoconch. Whorls six, exclusive of a smooth subulate protoconch of several whorls. Sculpture: on each whorl two rows of large prominent gemmules, divided by a broad and deep furrow. The gemmules are about sixteen to a whorl; transversely they are distributed in vertical rows, upper series elongate in a radial direction, as if two series were joined together, the lower ones round. The protoconch seems like that of *C. ridicula*, but none are complete in the series before me. Base with two spiral cords. Aperture subquadrate, canal short. Length 2·1; breadth 0·95mm.

A few imperfect specimens from 5-10 fathoms, Hope Islands. The recognition-mark of this species is the upper row of elongate gemmules, followed by a series of round gemmules. A fanciful resemblance to the Morse code of dots and dashes suggested a name.

CERITHIOPSIS TRIBULATIONIS, n.sp.

(Plate xl., fig.57.)

Shell small, cylindro-conic. Colour uniform pale cinnamon. Whorls six, and a crooked, subulate prodissoconch of three and one-half smooth whorls. Sculpture: three rows of gemmules to a whorl, linked spirally and vertically to enclose small deep meshes in the interstices. The uppermost gemmule-row is rather larger than its fellows, and, by contrast with the deep sutural furrow, conveys a slightly turreted aspect to the shell. On the last whorl there is an additional lower row of incipient gemmules, beneath which the base suddenly contracts. Aperture subquadrate, canal short. Length 2·5; breadth 0·85 mm.

Numerous specimens, from 5-10 fathoms, off the Hope Islands. Distinguished by its small size, subcylindrical shape, and treble row of large grains.

This and the following species, together with several undescribed forms, may be conveniently grouped in a new subgenus, which may be defined as follows.

JOCULATOR, subgen.nov.

Shell small, dextral, of ovate or bulbous contour, with a smooth subulate many-whorled protoconch. Type *Cerithiopsis ridicula* Watson.*

CERITHIOPSIS WESTIANA, n.sp.

(Plate xl., fig.58.)

Shell small, elongate-conical. Colour ochraceous, beads buff, protoconch white. Whorls five and one-half, with a smooth subulate protoconch of five and one-half whorls. Sculpture: two rows to a whorl of comparatively large gemmules, the lower row the smaller. A wider furrow runs between the rows of the same than between those of adjacent whorls. On the periphery of the last whorl is an unsegmented spiral cord, followed on the base by others in a diminishing series. Aperture subquadrate, canal short. Length 2·35; breadth 0·75 mm.

Numerous specimens from 5-10 fathoms, off the Hope Islands. The species appears to approach nearest to *C. turrigera* Watson,† from Hawaii, which has, however, four rows of beads on the last whorl, and is more contracted than the Queensland shell. The novelty is named in compliment to my friend, Miss Winifred West, to whom I am indebted for so many excellent illustrations.

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* Chall. Zool. Rep. xv. 1886, p.528, Pl.xxxviii., f.1.

†Watson, Chall. Rep. Zool., xv. 1886, p.529, Pl.xxxviii., f.2.

VERMICULARIA DEPOSITA, n.sp.

(Plate xli., fig.61.)

Shell small, coarsely irregularly radiately ribbed. Commences with a two-whorled protoconch like *V. caperata*,* which it envelopes, then extends in three or four loose advancing prostrate coils, finally rising free and erect for a short length. Diameter of tube 0·7 mm. Length of coil 4; breadth 2·5 mm.

A few dead and bleached specimens from 5-10 fathoms, Hope Island.

EPITONIUM KOSKINUM, n.sp.

(Plate xl., figs.59-60.)

Shell minute, conical acuminate, imperforate base flattened. Colour cream. Whorls eight, including a subulate protoconch of four smooth whorls. Sculpture: about ten prominent radial ribs traverse the whole whorl, both ribs and interstices being crossed by fine close punctate grooves. Aperture subcircular, externally margined by a varix. Length 2·15; breadth 1·0 mm.

A few specimens from 5-10 fathoms, Hope Islands. Probably the species attains a larger growth than my specimens represent. *Scalaria cerigottana* Sturany,† appears to be very like, but it is improbable that it should occur both in the Eastern Mediterranean and on the coast of Queensland.

PYRAMIDELLA ACUS Gmelin.

Voluta acus Gmelin, Syst. Nat. xiii. 1791, p.3451, for Martini, Conch. Cab. iv., Pl.157, f.1493-4; *Pyramidella maculosa* Forbes, in MacGillivray, Voy. Rattlesnake, ii. 1852, p.363; *P. punctata* Dall & Bartsch, Biolog. Soc. Washington, xvii. 1905, p.4.

Occurred alive in the sandy mud round Hope Island. The only reference to this species as Australian, is Forbes' note of it from the islets of Trinity Bay, a little south of our station.

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* These Proceedings, 1908, xxxiii. p.457, Pl.x., f.38.

†Sturany, Denk. Math.Naturwiss. K. Akad. Wien, lxiii. 1896, p.9, Pl.i., f.3-4.

ODOSTOMIA ABJECTA, n.sp.

(Plate xli., fig.62.)

Shell small, solid, oblong, imperforate. Colour uniform buff. Whorls four, and a heterostrophe protoconch, last whorl about equal to the remainder. Suture deep. Surface smooth but dull. Aperture ovate, bent in towards the axis, rounded anteriorly. Plication invisible externally. Length 1·65; breadth 0·7 mm.

Several specimens from 5-10 fathoms, off the Hope Islands.

ODOSTOMIA ADIPATA, n sp.

(Plate xlii., fig.73.)

Shell small, solid, ovate, imperforate, smooth and glossy. Colour white. Whorls three, plus a half-immersed heterostrophe protoconch, round, slightly shouldered at the summit, rapidly increasing, the last more than half the shell. Aperture large, ovate, effuse anteriorly, columellar margin reflected, fold slight and very oblique. Length 1·9; breadth 1·05 mm.

A few specimens, from 5-10 fathoms, off the Hope Islands.

ODOSTOMIA ANXIA, n.sp.

(Plate xli., fig.63.)

Shell small, rather solid, oblong, variable in shape, smooth and glossy, imperforate. Colour white. Whorls three, and a deeply immersed heterostrophe protoconch, rapidly increasing, rounded, the last three-quarters of the total length. Aperture very large, subauriculate, lip thickened and reflected columellar fold degenerate. Length 1·95; breadth 1·2 mm.

Three specimens, from 5-10 fathoms, off the Hope Islands.

ODOSTOMIA ARTICULATA, n.sp.

(Plate xli., figs.64-65.)

Shell small, slender-conical. Colour dull white. Whorls flattened, parted by deep sutures, seven and one-half, with a small heterostrophe apex. Sculpture: fifteen strong, elevated, sigmoid ribs cross the whorls perpendicularly and fade away on the base; they are rather narrower than their deep interstices, and are interrupted, from whorl to whorl, by the sutural trench. These radials over-ride two spiral threads, the upper of which alone persists on the spire-whorls as a supersutural keel. Columellar plication prominent. Length 3·3; breadth 1·0 mm.

The double peripheral thread and jointed aspect of the spire give this species an individuality. Several specimens were taken, in 5-10 fathoms.

Odostomia chorea, n.sp.

(Plate xli., fig.66.)

Shell small, solid, subcylindrical, imperforate. Colour white with a narrow gold band in the centre of each whorl, and another on the body-whorl just below the level of the lip-insertion. Whorls five and one-half, and an immersed heterostrophe protoconch. Sculpture: narrow, sharp perpendicular radial riblets, separated by rather broader interstices, extending from summit to base; on the last whorl these amount to sixteen; no trace of spiral sculpture. Aperture pyriform, rather oblique, rounded anteriorly, outer lip simple, a solid callus on the body-whorl, plication slight, deep seated, columellar margin reflected. Length 2; breadth 0·75 mm.

Several specimens, from 5-10 fathoms, off the Hope Islands; also from 17-20 fathoms, off Mast Head Island, and beach at Caloundra. The latter, which sometimes have an extra gold line on the base, are mentioned as perhaps a variety of *O. opaca*.* The latter is known only from Sydney.

Odostomia compta Brazier.

Odostomia compta Brazier, These Proceedings, i. 1877, p.259: *id.*, Hedley, Rec. Austr. Mus, iv. 1901, p.125, Pl. xvi., f.16-19: *O. eutropia* Melvill, Ann. Mag. Nat. Hist. (7), iv. 1899, p.94, Pl. i., f.14.

* Hedley, These Proceedings, xxx. p.525; xxxii. p.482.

Mr. Gabriel has lent me specimens of *O. eutropia*, identified by its author. These agree with a common and variable shell first described from the Chevert Collection. It was abundant at the Hope Islands. I have also traced it south to the Palm Islands and Port Curtis, and westerly to Van Diemen's Inlet in the Gulf of Carpentaria. Mr. Melvill notes it from Bombay and the Persian Gulf. Another Australian species which the same author has carried as far west, is *Capulus violaceus* Angas.*

Odostomia gumia, n.sp.

(Plate xli., fig.67.)

Shell small, solid, ovate-conical. Colour buff. Whorls five, and a heterostrophe protoconch. Sculpture: prominent spiral ribs, equal in breadth to their interstices, on the body-whorl eight, on the earlier three, summits of spirals polished, interstices finely radially striated. Aperture ovate, plication prominent, horizontal, columellar margin reflected over a narrow perforation. Length 3·55; breadth 1·6 mm.

One specimen, from 5-10 fathoms, Hope Island.

Odostomia humeralis Hedley.

Pyrgulina humeralis Hedley, These Proceedings, 1902, xxvii. p.11, Pl.iii., f.32. *Odostomia (Miralda) ima* Melvill, Proc. Malacol. Soc. vii. 1906, p.75, Pl.vii., f.15.

Mr. Gabriel has lent me a specimen from the Persian Gulf, identified by Mr. Melvill as *O. ima*, which exactly corresponds to large examples of *O. humeralis*, from 5-10 fathoms, off the Hope Islands. Both here and at Mast Head it occurred plentifully.

A near relation, perhaps indeed another synonym, seems to be *Pyrgulina eximia* Dautzenberg & Fischer.†

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* Melvill & Standen, Proc. Zool. Soc. 1901, ii. p.362.

† Dautzenberg & Fischer, Journ. de Conch. liv. 1906, p.196, Pl.vii., f.5.

Odostomia laquearia, n.sp.

(Plate xliii., fig.82.)

Shell small, subcylindrical, imperforate. Colour white. Whorls three, and a heterostrophe protoconch. Sculpture: strong elevated spiral cords, on the first, two; on the next, three; and on the last whorl, six; the basal being weaker, the deep interstices minutely punctate. A particularly broad deep furrow along the suture distinguishes the whorls. Aperture ovate, plication deep-seated, inner lip elevated. Length 1·4; breadth 0·6 mm.

A couple of specimens, from 5-10 fathoms, off the Hope Islands.

Odostomia macculloch, n.sp.

(Plate xli., figs 68-69.)

Shell small, conical-ovate, rather solid, subturreted. Colour dull white. Whorls five, and a partly sunk heterostrophe protoconch. Suture channelled. Sculpture: about thirty fine radial riblets, which project as a crown on the summit of the whorl, and fade away on the base Across the flat interstices run fine spiral threads, about thirty on the last whorl, and ten on the penultimate. Aperture large, elongate-ovate; columellar plication prominent. Length 4·5; breadth 1·55 mm.

Three specimens, from 5-10 fathoms. Named after my friend and colleague, Mr. A. R. McCulloch, who was a member of the party.

Odostomia migma, n.sp.

(Plate xli., fig.70.)

Shell elevate, conical, solid, imperforate. Colour white. Whorls six, and a heterostrophe protoconch, flat-sided, last sharply angled at the periphery. Sculpture: strong elevated spiral cords; on the upper whorls, three; on the last four, at and above the periphery, three feebler ones on the base, of which two wind into the aperture; interstices crossed by fine close radial threads. Aperture subquadrate, plication strong, horizontal. Length 3·35; breadth 1·4 mm.

A few specimens, from 5-10 fathoms, off the Hope Islands.

ODOSTOMIA SPERABILIS, n.sp.

(Plate xli., fig.71.)

Shell small, subcylindrical, imperforate, thin, subtranslucent, smooth and glossy. Colour milk-white. Whorls five, plus a deeply immersed heterostrophe apex, rather irregularly coiled, rounded, with deep sutures. Sculpture: a few irregularly disposed varices, most frequent on the upper whorls, and faint, microscopic radial striæ. Columellar fold slight, margin of aperture a little thickened. Length 3; breadth 1·1 mm.

A few specimens, from 5-10 fathoms, off the Hope Islands; also 15 fathoms, off the Palm Islands; and 17-20 fathoms, Mast Head Island.

This eccentric form perhaps belongs to the subgenus *Oceanida* de Folin, which I know only by secondhand references.

ODOSTOMIA TRIBULATIONIS, n.sp.

(Plate xli., fig.72.)

Shell small, solid, cylindro-conical, imperforate. Colour white. Whorls four, and a half-sunken heterostrophe apex. Suture deeply channelled. Sculpture: close straight perpendicular radial riblets, about twenty-two to the last whorl, ceasing abruptly at the periphery; their interstices are latticed by about half-a-dozen weak spiral threads. On base, four equally spaced, smooth spiral cords. Aperture ovate, columellar plication deeply entering. Length 1·65; breadth 0·8 mm.

A few specimens, from 5-10 fathoms, off the Hope Islands.

Pyrgulina lamyi Dautzenberg & Fischer,* appears to differ by fewer radials.

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* Dautzenberg & Fischer, Journ. de Conch, liv. 1906, p.190, Pl.vi., f.15.

TURBONILLA GABRIELI, n.sp.

(Plate xlii., fig 74)

Shell small, slender, acicular. Colour dull white. Whorls ten, and an obliquely projecting heterostrophe apex of about four whorls. Sculpture: about eleven strong straight perpendicular radial ribs, discontinuous from whorl to whorl, separated by deep smooth interstices of equal breadth. These ribs cease abruptly at the base, and are bounded by a slight spiral thread, which reappears on the spire-whorls. Base smooth. Length 3·75; breadth 0·7 mm.

A few specimens of this remarkably slender species, from 5-10 fathoms. It is named in honour of a member of our party, Mr. J. Gabriel. The subgenus *Nisiturris*, which is largely developed in these seas, includes this and *T. taylori*.*

TURBONILLA PERSCALATA, n.sp.

(Plate xlii., fig.75.)

Shell small, solid, gradate, subcylindrical, imperforate. Colour dull white, Whorls four, plus a half-immersed heterostrophe protoconch. Sculpture: about eighteen prominent radial ribs, which cross each whorl obliquely, and project on the summit. The broad interstices are traversed by fine spiral threads, varying in number and development. Aperture subquadrate, columellar fold distinct. Length 2·2; breadth 0·9 mm.

This species varies considerably, both in form and sculpture. Numerous specimens occurred, in 5-10 fathoms, Hope Islands.

TURBONILLA TAYLORI, n.sp.

(Plate xlii., figs.76-77.)

Shell small, acicular. Colour: ribs opaque white on a semi-translucent ground. Whorls seven, and a produced prostrate heterostrophe apex of about three whorls. Sculpture: about

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* Dall & Bartsch, Proc. U. S. Nat. Museum, xxx. 1906, p.341.

twenty-eight rather straight and narrow ribs cross the whorls obliquely, each terminating above in a round bead. Ribs more crowded on the last whorl, and continuing on the base. Spiral striæ appear in the basal interstices. Length 2·35; breadth 0·65 mm.

A few specimens, from 5-10 fathoms, off the Hope Islands. Another from 15 fathoms, off the Palm Islands. The species is chiefly distinguished by the bead-collar below each suture. It is named in honour of my companion on the trip, Mr. T. Griffith Taylor.

TURBONILLA TENUISSIMA, n.sp.

(Plate xlii , fig.78.)

Shell minute, acicular, thin, translucent, imperforate. Whorls nine, and a small heterostrophe protoconch, rounded and contracted at the sutures. Sculpture : first three whorls smooth, remainder crossed by about thirty fine, sharp, radial, arcuate ribs, which gradually vanish on the base. Length 2·3; breadth 0·5 mm.

A few specimens, from 5-10 fathoms, Hope Islands.

TURBONILLA TRIBULATIONIS, n.sp.

(Plate xlii., figs.79-80.)

Shell small, turreted. Colour dull white. Whorls seven, and a produced recumbent heterostrophe apex. Sculpture: about twenty-one prominent, slightly bowed, radial ribs, whose summits, linked by a spiral cord, project as a toothed crown above the whorl. At the basal angle another spiral cord, knotted by the passage of the ribs, encircles the shell, beyond which the ribs diminish. Fine spiral grooves occupy the interstices of the radials. Aperture oblong, plication not apparent from the exterior. Length 4·1; breadth 1·25 mm.

This appears to be related to *T. belonis* Melvill & Standen,* than which it is smaller, and more coarsely sculptured. A few specimens, from 5-10 fathoms.

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* Melvill & Standen, Journ. of Conch. viii. 1897, p.303, Pl.x., f.56.

Eulima conaminis, n.sp.

(Plate xliii., figs.83-84.)

Shell thin, small, imperforate, conical, varying from stout to slender. Colour variable, uniform pale buff to chocolate or white with a peripheral orange line. Whorls eight, rounded or angular, smooth and glossy; sutures impressed. Aperture simple, angled above, rounded below. Specimen figured, length 1·65; breadth 0·7 mm. Another specimen, length 1·85; breadth 0·9 mm.

Var. angulata, var.nov.

(Plate xliii., fig.84.)

Whorls conspicuously keeled at the periphery.

This variable species occurred plentifully, in 5-10 fathoms, off the Hope Islands. I also procured it in 15 fathoms, off the Palm Islands, and Mr. A. U. Henn took it off Cape Sidmouth.

Eulima piperita, n.sp.

(Plate xliii., fig.85.)

Shell small, slender-conic, apex mucronate. Whorls nine. Colour white, with groups of small chocolate dots clustered around the periphery. Aperture pyriform, columella straight, its margin a little expanded and reflected, a thin callus on the body-whorl. Length 2·5; breadth 1 mm.

A few specimens, from 5-10 fathoms, off the Hope Islands. The dot-painting affords a ready recognition of this species.

Cymatium pyrum Linné.

Murex pyrum Linné, Syst. Nat. x. 1758, p.749; *id.*, Hanley, Ips. Linn. Conch. 1855, p.290. *Triton clavator* Reeve, Conch. Icon. ii., Triton, 1844, Pl.iii., f.7.

A specimen, from 5 fathoms within Cairns Reef, is the first appearance of this shell in Australia.

Also unrecorded for Australia is *Cymatium pfeifferianum* Reeve,* which I found on the beach at Dunk Island, some distance south.

CYMBIUM FLAMMEUM Bolten.

Cymbium flammeum Bolten, Mus. Bolt. (2), 1798, p.151, for Martini, Conch. Cab. iii. 1777, p.59, Pl. lxxiv., f.780. *Voluta diadema* Lamarck, Ann. du Mus. xvii. 1811, p.57.

This shell is common along the whole coast of Queensland, and has been reported from Moreton Bay, Mast Head Island, Dunk Island, Cape Grafton, Cape Bedford, Torres Strait, and the Gulf of Carpentaria, under the names of *Melo diadema* Lamarck, *M. mucronatus* Broderip, *M. broderipii* Gray, *Cymbium ducale* Lamarck, and *C. georginæ* Gray. All these synonyms are preceded by Bolten's name, hitherto ignored.

It was of considerable importance to the aboriginals, who ate the animal, and used the shell for a canoe-bailer, for a cooking utensil, for personal adornment, and for wommera-handles. The following native names have been collected: niugan, Moreton Bay, Tom Petrie; ping-ah, Dunk Island, Banfield; ji-gai, Cape Grafton, Roth; dir-hai, Cape Bedford, Roth; edzera, Darnley Island, Jukes; alup, Torres Strait, Haddon; and pe-ra, Batavia River, Roth.

An old worn shell, which I saw decorating a fence on Murray Island, is $14\frac{3}{4}$ inches long, and $10\frac{1}{2}$ broad. The egg-capsules are described by Banfield.†

In Shark Bay, Western Australia, the animal is infested by *Aspidogaster macdonaldi* Monticelli.‡

MARGINELLA ANXIA, n.sp.

(Plate xliii., figs.86-87.)

Shell small, broadly ovate, involute, a heavy and broad callus spread over each end. Colour milk-white. Adult smooth and

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* Reeve, Conch. Icon. ii., Triton, 1844, Pl.iv., f.14.

† "The Confessions of a Beachcomber," 1908, p.148.

‡ Macdonald, Trans. Linn. Soc. Zool (2), i., 1879, p.210, Pl.xxxiv., f.1-5.

glossy; immature shell with fine close spiral punctate grooves. Aperture crescentic, canaliculate at either end. Outer lip thickened and reflected, finely closely denticulate within. Inner lip with a thick callus deposit. In the young (fig.87) there are five columellar plaits decreasing gradually in size, the least about the centre of the aperture; in the adult, two large, and one small plait alone are visible. Length 2·2; breadth 1·6 mm.

A few specimens, from 8 fathoms, Weary Bay. I also took it, in 15 fathoms, off the Palm Islands; and in 17-20 fathoms, off Mast Head Reef.

TURRIS GRANOSUS Helbling.

Murex (Fusus) granosus Helbling, Abh. Privatges. Bohm. iv. 1779, p.116, Pl.2, f.16; *id.*, von Martens, Malak. Blätt. xvi. 1869, p.235; *id.*, Dall, Journ. of Conch. xi. 1906, p.291; *Pleurotoma carinata* Griffiths & Pidgeon, Mollusca and Radiata, 1834, p.599, Pl.23, f.2; *id.*, Weinkauff, Jahrb. d. deut. Malak. Gesell., ii., 1875, p.288, Pl.ix., f.2; *Pleurotoma speciosa* Reeve, Conch. Icon. i. 1843, Pl.ii., f.9; *Pleurotoma kienerii* Doumet, Mag. de Zool. 1840, Moll., Pl.10; *id.*, Smith, Ann. Mag. Nat. Hist. (6), xiv. 1894, p.160.

A few specimens were dredged in 5-8 fathoms, Cairns Reef. The species is hitherto unknown from Australia. Mr. Gabriel identified a specimen we took, with a shell from the Belcher Collection in the British Museum, marked "*Pleurotoma kieneri* Doumet."

DRILLIA LIVIDA Gmelin.

Strombus lividus Gmelin, Syst. Nat. xiii. 1791, p.3523, for Chemnitz, Conch. Cab. ix. 1786, Pl.136, f.1269-70. *Pleurotoma auriculifera* Lamark, An. s. vert. vii. 1822, p.91; *id.*, Deshayes, *op. cit.* 2 ed. ix. 1843, p.345.

In the absence of a figure and a type, the Linnean *Strombus lividus* is, according to Hanley,* unrecognisable. Under these circumstances, it is better to adopt the name of Gmelin, securely based on the figure of Chemnitz, than to use Lamarck's *auricu-*

* Hanley, Ips. Linn. Conch. 1855, p.278.

lifera. The claim of *lividus* is also supported by Deshayes, in commenting on Lamarck's name.

The species has not appeared before in Australian waters. We dredged a few examples in 5-10 fathoms.

Glyphostoma tribulationis, n.sp.

(Plate xlii., fig.81.)

Shell small, solid, biconical, angled at the periphery. Colour white or buff. Whorls six, including a small smooth two-whorled protoconch. Sculpture: about a dozen undulatory radial ribs, equal in breadth to their rounded interstices, arise at the suture, are most prominent on the shoulder, and fade on the base. Ascending the spire, these radials gradually diminish. About twelve small spiral threads, which traverse ribs and furrows alike, are evenly distributed between the shoulder and the anterior extremity. Finally, a secondary sculpture of fine close grains, arranged radially and spirally, is spread over the whole surface, giving a "gritty" aspect to the shell. Aperture narrow, protected by a strong projecting varix, the outer lip with two or three ill-defined tubercles within, canal short. Length 4·75, breadth 2·5 mm.

Abundant in 5-10 fathoms, at Hope Island. I found a small form of it, in 15 fathoms, off the Palm Islands. The strong shoulder-angle and sanded surface are the principal features. Cape Tribulation is on the mainland, opposite the Hope Islands.

Glyphostoma aliceæ Melvill & Standen.

(Plate xliii., fig.88.)

Glyphostoma aliceæ Melvill & Standen, Journ. of Conch. viii. 1895, p.95, Pl. ii., f.15; *id.*, Hedley, Mem. Austr. Mus. iii. 1899, p.471.

Hitherto this species has not been recorded as Australian. It was originally described from the Loyalty Islands, and then identified from Funafuti. The dark patches on the lips are useful recognition-marks. As the original figure is vague, I have here illustrated a shell, 14 mm. long, from 5-8 fathoms, Hope Islands. The Queensland example is the largest seen.

Another member of the genus unrecorded for Australia, is *Glyphostoma ocellatum* Jousseaume,* of which I took an example at Green Island, off Cairns.

Mangelia anxia, n.sp.

(Plate xliii., fig.89.)

Shell small, solid, subcylindrical, shoulder sloping, body perpendicular, base excavate, sharply angled at base and shoulder. Colour: all specimens seen are faded, but appear to have been buff, the protoconch and spots on the lower whorls darker, the basal keel white. Whorls three, and a protoconch of three and one-half whorls, of which the first is turbinate, slightly tilted and engraved with microscopic spirally punctured lines, followed by two transitional whorls keeled at periphery, and ornamented by fine close obliquely radiating riblets. Adult sculpture: on the body-whorl, fifteen spiral cords, of which the third and eighth are prominent, expressing the angle above and below the barrel of the whorl, the basal cords broken into beads; penultimate with six, and antepenultimate with three spirals. Broader than the spirals are the perpendicular radials, fourteen on the last whorl, and proportionately fewer on the rest. Commencing at the suture and vanishing on the base, they raise tubercles at the intersection of the spirals. The resulting meshes enclose deep pits in which is a microscopic shagreen surface. Aperture contracted, straight above, flexed below, fortified by a broad strong varix, out of which a deeply notched subcircular anal sulcus is excavated. The spiral sculpture traverses the varix. Within the outer lip are four tubercles. Inner lip excavate. Canal short, broad. Length 3·3; breadth 1·1 mm.

Several specimens, from 5-10 fathoms, Hope Island. On the assumption that it was immature, a single example from Mast

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* Jousseaume, Bull. Soc. Zool. France, ix. 1884, p.186, Pl.iv., f.4; Melvill & Standen, Journ. of Conch. viii. 1897, p.401.

Head Island was catalogued (These Proceedings, xxxii. p.484) as *Clathurella edychroa* Hervier,* not otherwise known from Australia. With a larger series, it is now apparent that the Australian shell consistently differs from the Lifuan, by a whorl less, smaller size, and by coarser sculpture. Other members of this peculiar group are *M. cancellata* Beddome, *M. telescopialis* and *M. pentagonalis* Verco, and *M. lutaria* Hedley. A more distant relation is *M. hilum* Hedley.

Mangelia calcata, n.sp.

(Plate xliv., fig.90.)

Shell small, solid, ovate, turreted. Colour uniform grey. Whorls, four remaining [apex missing in the only example seen]. Sculpture: oblique, wave-like, radial folds, five to a whorl, expanded and projecting prominently at the summit of each whorl. The whole surface overrun by fine, close-packed, spiral threads. Aperture linear, sulcus an almost closed tube at the top of a bold varix, outer lip insinuate near the base, canal very short. Length 3·6; breadth 1·5 mm.

A single example, from 5-10 fathoms, Hope Island. This is a notable shell; the broad flanges suggest the idea of being trodden under foot; the subtubular posterior notch and the closely corded sculpture are both peculiar.

Mangelia gracilenta Reeve.

(Plate xliv., fig.91.)

Pleurotoma gracilenta Reeve, Conch. Icon. i. Pl.xiv., f.114; *P. contracta* Reeve, *op. cit.* f.116,(1843); *P. fusoides* Reeve, *op. cit.* Pl.xxxviii., f.349,(1846); *fide* E. A. Smith, Zool. Coll. Alert, 1884, p.39.

This species has not been cited from Queensland, but I had already recognised it, from 15 fathoms, off the Palm Islands, from Mapoon, from off the Horsey River, and from 5 fathoms,

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* Hervier, Journ. de Conch. xliv. 1897, p.146; xlv. 1897, p.109, Pl.iii., f.2.

Van Diemen's Inlet, Gulf of Carpentaria. Mr. J. C. Gabriel confirmed this identification by comparison with the type in London. As the figures of the species are all unsatisfactory, I add an illustration of a Hope Island shell, 8 mm. in length. The species was common in 5-10 fathoms. For this species Böttger* formed a new subgenus *Paraclathurella*.

Mangelia infulata, n.sp.

(Plate xliv., fig.92.)

Shell small, very solid, regularly biconical, sharply angled at the shoulder. Colour white, or pale buff with narrow bands of darker buff. Whorls five, including a protoconch of two smooth rounded whorls, last whorl two-thirds of the shell's length. Sculpture: on the body-whorl are eight widely spaced thick and prominent vertical ribs radiating from the suture, and vanishing on the base. On the shoulder these are linked and overrun by a spiral cord of nearly equal calibre. This sculpture is repeated on the penultimate, where the radials are smaller and closer. On the antepenultimate the spiral cord degenerates, and the radials are closer, rounder, and more oblique. Apart from this, the shell has, in general, a smooth expression, but a few faint spirals mark the base, while still fainter scratches traverse the rest of the shell. Aperture narrow, protected by a heavy outstanding varix, anteriorly with a semicircular excavation, followed by a tubercle on either side. Canal short, broad, effuse. Length 3·55; breadth 1·7 mm.

Numerous specimens, in 5-10 fathoms, Hope Island. I took it also, in July, 1901, in 15 fathoms, east of Great Palm Island.

Mangelia angulata Reeve,* appears, from the figure, to be larger and to have a sharper, more prominent, peripheral keel. Possibly the record of that species from Cape York† was based on *M. infulata*.

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* Böttger, Nachr. deut. Malak. Gesell. xxvii. 1895, p.56.
* Conch. Icon. iii. Pl.viii., f.62.
† Brazier, Proc. Linn. Soc. N. S. Wales, i. p.160.

M. apollinea Melvill, from the Persian Gulf,* is also larger, but proportionately more slender.

Mangelia naufraga, n.sp.

(Plate xliv., figs.93-95.)

Shell solid, narrowly fusiform. Colour cream. Whorls seven, including a small, smooth, two-whorled protoconch. Sculpture: about eight prominent curved ribs undulate the suture, and extend to the base; these are divided by broad and gently sloping interstices. Across both ribs and furrows run fine, close, spiral threads, amounting to 32 to 36 on the last whorl, and about one-half that number on the penultimate. Between the threads are microscopic radial bars. Aperture oval, anterior notch not apparent, outer lip protected by a strong rib-varix, canal short. Length 6; breadth 2·3 mm.

Var. conata, var.nov.

(Plate xliv., fig.94.)

Shorter and broader than the species in chief, pale brown with a chocolate peripheral band.

The reef on which the "Endeavour" was wrecked, in 1770, lies immediately south of the scene of our dredging.

A few specimens of the typical form and one of the variety, from 5-10 fathoms, off the Hope Islands. I also took a few of the typical form, in 17-20 fathoms, off Mast Head Island; and received one from Mr. J. Brazier, which he dredged in Torres Strait.

In general character *Cithara striatella* Smith,† resembles this, but the novelty is smaller, comparatively narrower, and closer ribbed. *Mangelia agna* Melvill & Standen,‡ is more slender and has fewer ribs.

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* Melvill, Proc. Malacol. Soc. vi. 1904, p.166, Pl.x., f.20.

† Smith, Ann. Mag. Nat. Hist. ser.5, xiv. 1884, p.327.

‡ Melvill & Standen, Journ. of Conch. viii. 1896, p.279, Pl.ix., f.12.

MANGELIA PERISSA, n.sp.

(Plate xliv., figs.96-97.)

Shell thin, ovate-fusiform, spire acuminate. Whorls five, and a two-whorled protoconch, the latter subulate with spiral punctate grooves. Colour dead white except a cinnamon protoconch. Sculpture: spiral threads predominate, amounting on the body-whorl to about thirty, not impinging on a broad anal fasciole, beneath this strong and widely spaced, becoming feebler and closer below the periphery, but waxing stronger on the back of the canal; the penultimate carries six such spirals, then three, then two on the earlier whorls. The radials are stronger on the younger whorls, but decrease on the older; in the last whorl they fade away about the periphery, and in the penultimate scarcely reach across the whorl. In every case they are overriden by the spirals. Aperture elliptical; inner lip overlaid by a substantial callus which, opposite the sulcus and at the base of the canal, is provided by a small but sharp tubercle. Outer lip produced externally into a prominent varix, and beset within by a row of small tubercles. Canal short and broad. Length 7·4; breadth 2·9 mm.

A few specimens, from 5-10 fathoms, Hope Island. The extreme reduction of radial sculpture in this group is rare. I cannot recall any near ally of this peculiar shell, some aspects of which resemble *Daphnella.*

MANGELIA RIGORATA, n.sp.

(Plate xliv., figs.98-99.)

Shell small, oblong, turreted, rather solid. Colour dull white. Whorls six, including a smooth three-whorled protoconch, whose initial whorl is eccentric. Sculpture: from ten to twelve very prominent, close, radial ribs, widest apart on the back of the last whorl, and becoming closer on the earlier whorls. These ribs project on the summit of the whorl and fade gradually on the base. The last whorl is encircled by twelve to fourteen strong spiral cords, which override both ribs and interstices; on the penultimate there are four such cords, and on the antepenultimate three. Between and parallel to the spiral cords are fine, close, microscopic hair-lines. Aperture narrow linear, with deep sinus and prominent varix. Length 3·8; breadth 1·5 mm.

Some variation in contour occurs, some individuals being shorter and broader than others. The species is characterised by its straight, narrow form, gradate spire, and strongly modelled sculpture. Several specimens, from 5-10 fathoms, off Cairns Reef.

Mitra amabilis Reeve.

Mitra amabilis Reeve, Conch. Icon. ii. Pl.xxxiii., f.274(March, 1845); *id.*, Proc. Zool. Soc. 1845, p.53(Sept. 1845); *id.*, Jickeli, Jahrb. Malak. Gesell. 1874, p.49, Pl. ii., f.10; *id.*, Sturany, Denk. kais. Akad. Wiss. lxiii. 1903, p.246, Pl.vii., f.9.

This species is new to Australia. Two specimens were taken at Hope Island, and I had previously found it at the Palm Islands.

Mitra deshayesii Reeve.

Mitra deshayesii Reeve, Conch. Icon. ii. Pl.xxii., f.170(Nov. 1844); *id.*, Proc. Zool. Soc. 1844, p.182(Feb. 1845).

One specimen, from the Hope Islands, adds this species to the Australian fauna.

Mitra lucida Reeve.

Mitra lucida Reeve, Conch. Icon. ii. Pl. xxxiii., f.266(March, 1845); *id.*, Proc. Zool. Soc. 1845, p.51(Sept. 1845).

Not previously noted in Australia. Mr. J. C. Gabriel identified a Hope Island specimen by comparison with the type in the British Museum. I have also taken it at the Palm Islands.

Mitra sanguisuga Linné.

Voluta sanguisuga Linné, Syst. Nat. x.1758, p.732; *id.*, Hanley, Ips. Linn. Conch. 1855, p.228. *Mitra sanguisuga* Fischer & Dautzenberg, Journ. de Conch. lii. 1906, p.385.

A single specimen, from the Hope Islands, adds this species to the Australian fauna.

MITRA SUBDIVISA Bolten var. INTERMEDIA Kiener.

Vexillum subdivisum Bolten, Mus. Bolt. (2), 1798, p.139, for Chemnitz, Conch. Cab. x. 1788, p.171, Pl.151, f.1436-7; *Mitra intermedia* Kiener, Spec. des Coq., *Mitra*, 1839, p.73, Pl.22, f.70.

The nomenclature of this form proceeded thus: Chemnitz figured and described polynomially two species of *Mitra* as one. To the amalgam, Gmelin, in 1791, gave the name of *Voluta subdivisa.* Seven years later this specific name was, by Bolten, restricted to Chemnitz' figures 1436-7, leaving the other shell, illustrated by figs. 1434-5, to bear the title of *Mitra lyrata*, subsequently imposed on it by Lamarck.* An elongate form was distinguished by Kiener as *Mitra intermedia*, but Deshayes† reduced it to varietal rank. Reeve's Monograph of Mitra, so slovenly in preparation, so disorderly in presentation, gives no help in unravelling a complicated synonymy.

The shell has been reported by Melvill & Standen‡ from Murray Island. Besides the present record of the Hope Islands, I have traced it south to Dunk and Palm Islands.

While on the subject of Mitra, I might discuss a puzzling record of *Mitra decurtata* Reeve, from Torres Strait, by Melvill & Standen.§ These authors have stated|| that "*M.(Strigatella) decurtata* Reeve = *M. scutulata* Lam."

In the first place, it may be remarked that *scutulata* dates back to Gmelin; the shell was not known to Lamarck. Secondly, it is not obvious why the younger name of Reeve was used in preference to the older. Thirdly, Reeve's figure (Mitra, f.154) of *M. decurtata* is unlike that of Chemnitz¶ on which *scutulata* was based. An example of *M. scutulata* taken by Dr. Finckh, on Lizard Island, a short distance from the Hope Islands, shows it to occur on the coast, and I will therefore assume that this it is which Melvill and Standen identified from Haddon's Collection.

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* Lamarck, Anim. s. vert. vii. 1822, p.308.

† Deshayes, Anim. s. vert. (2), x. 1844, p.316.

‡ Melvill & Standen, Journ. Linn. Soc., Zool. xxvii. 1899, p.158.

§ Melvill & Standen, *op. cit.* p.158.

|| Melvill & Standen, Journ. of Conch. viii. 1895, p.101.

¶ Conch. Cab. x. Pl.151, f.1428-9.

NASSARIA MORDICA, n.sp.

(Plate xliv., fig.100.)

Shell of medium size, very solid, biconical, false umbilicate. Colour buff, the cords on the rib-summits of the periphery picked out with chocolate, aperture flesh-tint. Whorls seven, and a protoconch of three smooth whorls. Sculpture : seven prominent oblique rounded ribs cross each whorl, and mount the spire continuously, the last forming a varix to the aperture. These are crossed by spiral cords, about fifteen to the last and five to the penultimate whorl, two or three of the peripheral cords predominating over the rest Across these run close fine radial laminæ, puckered into imbricating scales on crossing the spirals. Canal open, short, recurved, the canal-tips of previous apertures enclosing with a frill a false umbilicus. Aperture narrow-oval; on the right side are seven evenly spaced entering ridges which penetrate a short distance only; externally they end abruptly at a circumferential groove. Posteriorly the aperture ends in a furrow followed by a tubercle. The upper part of the inner lip is clear of obstructions, but the lower is occupied by five strong and deeply penetrating spiral ridges which do not reach the free edge of the columellar lip. Length 16; breadth 8 mm.

A few specimens, from 5-10 fathoms, off the Hope Islands. Mr. J. Brazier has given me specimens which he dredged, in 30 fathoms, off Darnley Island.

Fusus cereus Smith,* from this coast, has a general resemblance, but the columellar ridges of the novelty readily distinguish it. The rather artificial character of the columella has constrained me to refer this to *Nassaria*, but I have a suspicion that ultimately both *Fusus imbricatus*† Smith, and *F. cereus* Smith, may be relegated to the neighbourhood of *Thais*.

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* Smith, Zool. Coll. Alert, p.46, Pl. v., f.D.

† Smith, Journ. Linn. Soc., Zool. xii. 1876, p.540, Pl. xxx., f.3:(?)= *Lataxiena lataxiena* Jousseaume, Bull. Soc. Zool. France, viii. 1883, p.188, Pl. x., f.1.

Pyrene albina Kiener.

Columbella albina Kiener, Coq. Viv. 1841, p.32, Pl. xiii., f.4; *id.*, Hervier, Journ. de Conch. xlvii. 1899, p.320; *id.*, Pace, *op. cit.* l. 1902, p.416.

Two specimens, from the Hope Islands, are the first examples of this species to be recognised from Australia.

Another member of the genus, new to Australia, is *Pyrene peasei* v. Martens & Langkavel,* which was collected at Lizard Island, not far from the Hope Islands, by Dr. A. E. Finckh.

Retusa impasta, n.sp.

(Plate xliv., fig.101.)

Shell rather solid, subcylindrical, a crown marked off by a sharp constriction below the summit, faintly constricted at the waist and gently swollen below, anteriorly truncated, posteriorly rounded, base imperforate. Colour dull white or faintly tinged with yellow. Sculpture: about forty fine, close, longitudinal threads traverse the whole length of the shell. These are cut by about thirty sharp, narrow, concentric grooves, which strengthen on crossing the crown and penetrate the apical crater. Aperture a narrow slit for the anterior two-thirds, then enlarging to a pyriform orifice; inner lip overlaid with a substantial callus. Summit-perforation one-fifth of its diameter, deep and narrow. Length 3·45; breadth 1·35 mm.

An abundant species off the Hope Islands, in 5-10 fathoms. Off the Palm Islands, in 15 fathoms, I found it equally common. While serving as naturalist to the Geographical Society's Expedition to New Guinea, Mr. W. W. Froggatt gathered specimens at Prince of Wales Island, Torres Strait, in 1885.

A member of the "starved" section of *Retusa*; this appears to be nearest to *Utriculus famelicus* Watson,† but has a rougher sculpture, a narrower waist, and a prominent collar.

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* Mart. & Langk., Donum Bismarck., 1871, p.23, Pl.i., f.17; Pace, Journ. de Conch. l. 1902, p.419.

† Chall. Rep. Zool. xv. 1886, Pl. xlix., f.1, p.653.

Retusa pharetra, n.sp.

(Plate xliv., fig.102.)

Shell small, rather thin, cylindrical, abruptly truncate above, straight at the sides and produced below, narrowly umbilicate. Colour cream, sometimes alternating with dull white in five or six indefinite belts of equal breadth. Sculpture: the whole surface is cut into small facets by the crossing at right angles of fine, close, longitudinal threads and spiral grooves. These grooves cease near the summit, and leave uncut the threads that cross the crown and descend into the apical crater. Aperture rising above the last whorl, narrow and straight for the upper two-thirds, then dilating. The columella rather broadly reflected over the perforation. Apical crater one-third of the shell's diameter. Length 2·25; breadth 1·0 mm.

A few specimens, from 5-10 fathoms, Hope Island, and one from Mast Head Island. In texture, the novelty is intermediate between *R. bizona* A. Adams, and *R. granosa* Brazier, but it is smaller and more cylindrical than either.

Cylichna collyra Melvill.

Cylichna collyra Melvill, Proc. Malacol. Soc. vii. 1906, p.79, Pl. viii., f.25.

Mr. Gabriel lent me an example of this from the Gulf of Oman, determined by the author of the species. A few examples, from 5-10 fathoms, off the Hope Islands, prove to be identical.

Pseudoceros kentii von Graff.

Pseudoceros kentii Saville Kent, Great Barrier Reef, 1893, p.362, Pl. xiii., f.1; *id.*, Haswell, Trans. Linn. Soc., Zool., 2nd Ser., ix. 1907, p.465.

On the north arm of Cairns Reef, at low tide, we captured an *Hexabranchus marginatus** Quoy & Gaimard, which we brought alive to the "Lotus." We had on board a copy of Kent's

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* Bergh, Siboga Expedition, Livr. xxv. 1905, Pl. i., f.1,2.

"Barrier Reef," and, when the mollusc retracted the gill-plumes, its identity with the figure of the so-called planarian was clear to all the party.

EXPLANATION OF PLATES XXXVI.-XLIV.

Plate xxxvi.

Figs. 1-4.—*Chlamys corymbiatus* Hedley.
Figs. 5-8.—*Cuna praecalva* Hedley.
Figs. 9-10.— ,, *capillacea* Hedley.
Figs. 11-12.—*Rochefortia viastellata* Hedley.
Figs. 13-15.—*Sportella sperabilis* Hedley.

Plate xxxvii.

Fig. 16.—*Phacoides eucosmia* Dall.
Fig. 17.— ,, *rugosus* Hedley.
Fig. 18.— ,, *sperabilis* Hedley.
Figs. 19-21.—*Cardium lobulatum* Deshayes.
Figs. 22-23.—*Sportella jubata* Hedley.
Figs. 24-27.—*Gafrarium catillus* Hedley.

Plate xxxviii.

Figs. 28-29.—*Chione scandularis* Hedley.
Figs. 30-32.—*Tellina ctesiaca* Hedley.
Fig. 33.—*Arcopagia dapsilis* Hedley.
Figs. 34-36.—*Semele isosceles* Hedley.
Figs. 37-39.—*Theora nasuta* Hedley.

Plate xxxix.

Figs. 40-42.—*Liotia tribulationis* Hedley.
Figs. 43-45.— ,, *anxia* Hedley.
Figs. 46-48.—*Cyclostrema anxium* Hedley.

Plate xl.

Figs. 49-51.—*Cyclostrema torridum* Hedley.
Fig. 52.—*Obtortio vulnerata* Hedley.
Figs. 53-54.—*Triphora tribulationis* Hedley.
Fig. 55.—*Cerithiopsis pinea* Hedley.
Fig. 56.— ,, *telegraphica* Hedley.
Fig. 57.— ,, *tribulationis* Hedley.
Fig. 58.— ,, *westiana* Hedley.
Figs. 59-60.—*Epitonium koskinum* Hedley.

Plate xli.

Fig. 61.—*Vermicularia deposita* Hedley.
Fig. 62.—*Odostomia abjecta* Hedley.
Fig. 63.— ,, *anxia* Hedley.
Figs. 64-65.— ,, *articulata* Hedley.
Fig. 66.— ,, *chorea* Hedley.
Fig. 67.— ,, *gumia* Hedley.
Figs. 68-69.— ,, *maccullochi* Hedley.
Fig. 70.— ,, *migma* Hedley.
Fig. 71.— ,, *sperabilis* Hedley.
Fig. 72.— ,, *tribulationis* Hedley.

Plate xlii.

Fig. 73.—*Odostomia adipata* Hedley.
Fig. 74.—*Turbonilla gabrieli* Hedley.
Fig. 75.— ,, *perscalata* Hedley.
Figs. 76-77.— ,, *taylori* Hedley.
Fig. 78.— ,, *tenuissima* Hedley.
Figs. 79-80.— ,, *tribulationis* Hedley.
Fig. 81.—*Glyphostoma tribulationis* Hedley.

Plate xliii.

Fig. 82.—*Odostomia laquearia* Hedley.
Fig. 83.—*Eulima conaminis* Hedley.
Fig. 84.— ,, ,, var. *angulata* Hedley.
Fig. 85.— ,, *piperita* Hedley.
Figs. 86-87.—*Marginella anxia* Hedley.
Fig. 88.—*Glyphostoma aliceæ* Melvill & Standen.
Fig. 89.—*Mangelia anxia* Hedley.

Plate xliv.

Fig. 90.—*Mangelia calcata* Hedley.
Fig. 91.— ,, *gracilenta* Reeve.
Fig. 92.— ,, *infulata* Hedley.
Fig. 93.— ,, *naufraga* Hedley.
Figs. 94-95.— ,, ,, var. *conata* Hedley.
Figs. 96-97.— ,, *perissa* Hedley.
Figs 98-99.— ,, *rigorata* Hedley.
Fig. 100.—*Nassaria mordica* Hedley.
Fig. 101.—*Retusa impasta* Hedley.
Fig. 102.— ,, *pharetra* Hedley.

CONTRIBUTION TO OUR KNOWLEDGE OF AUSTRALIAN *HIRUDINEA*.

Part iii.

By E. J. Goddard, B.A., B.Sc., Linnean Macleay Fellow of the Society in Zoology.

(Plates xlv.-xlvi.)

The present paper deals with two species of *Glossiphonia* Johnson, 1816, (syn. *Clepsine* Savigny,1820), one of which is new to science, the other a cosmopolitan form now recorded for the first time from the Australian region; and also with a description of our commonest and longest known aquatic Arhynchobdellid, which I find is now to be known as *Limnobdella australis* in place of *Hirudo quinquestriata* after taking into consideration the generic characters, and giving preference to Bosisto's prior specific name rather than to Schmarda's *quinquestriata*.

Since describing two species of *Glossiphonia* in these Proceedings (1908, p.320), and *Dineta*, gen.nov. (*op. cit.* p.854), I have been fortunate enough in collecting to obtain a number of aquatic Hirudinea, the greater number of which belong to the genus *Glossiphonia*.

I can here preliminarily also record the occurrence of *Herpobdella* (syn. *Nephelis*), specimens of which I obtained in the vicinity of Sydney, and in the Maitland District.

I have met with specimens of *Glossiphonia* in a very large number of places in the coastal district, including Fairfield, Narara, Auburn, Oberon, Omega, Gerringong, and Maitland. In some cases, as in creeks, they are found on floating weeds or reeds; in the case of ponds or dams, one finds them frequently, in abundance, adhering to floating or submerged pieces of wood. I have found that species of this genus are always associated with a freshwater gastropod, *Bythinia australis* Tryon, etc. Indeed, wherever I have noticed specimens of these molluscs, I have never yet failed to obtain specimens of *Glossiphonia*, nor have I ever obtained specimens where these molluscs do not occur. This association between freshwater gastropods and Glossiphonid species is not unusual in many parts of the world, and there can be no doubt that the former form the main host of these leeches. At Wallis's Creek I found specimens in intimate association with the molluscs.

Grube recorded *Clepsine octostriata* from Rockhampton (New Holland); and the same genus is represented in the vicinity of Brisbane, according to the evidence of Mr. Henry Tryon. I have found no record of the occurrence of the genus in Victoria, but I think there can be no doubt that the genus is extremely abundant throughout Eastern Australia. I am indebted to Mr. Geoffrey Smith, of Oxford, for specimens which he obtained at Great Lake, Tasmania, representing a specially interesting new species. These were obtained under stones, along the margin of the lake, and associated with a species of *Ancylus*.

I must also express my thanks to Mr. Tillyard for specimens from Auburn, and to Mr. Thomas Steel for some excellently extended and preserved individuals of *Limnobdella*, which have been of the greatest use to me in working out that form.

Glossiphonia intermedia, sp.nov.

The individuals of this new species were obtained at Orphan School Creek, near Fairfield. Only two specimens were secured, and these were found attached to submerged pieces of timber in a pond in the bed of the creek, the only other form of life noticeable being *Bythinia australis*.

The specimens, on being placed in an aqueous solution of corrosive sublimate, quickly rolled themselves into a ball, after the fashion of Oniscus, as do most species of the genus. This form is a very active species, and, when disturbed, moves fairly rapidly, unlike most species, and after the fashion of Herpobdella and Limnobdella.

External characters.—The anterior half of the body is of a blue-grey colour dorsally, the posterior half being a dirty yellow. When removed from the substratum, the cæca of the crop were plainly visible, and had a greenish colour, the last pair in one individual being reddish-brown. When fully extended, the body was greatly attenuated towards the anterior end, the posterior half being the widest body-portion and this in uniformity. Length in state of extension 33; length in state of contraction 14; greatest breadth 4·6 mm. The ventral surface is deeply concave in killed specimens, the lateral margins of the body projecting downwards for a considerable distance.

No ornamentation, in the way of pigmented areas or prominent sensory papillæ, was noted in the living individuals, but in the killed specimens sensory papillæ are plainly visible. These can be traced from the posterior extremity forwards, as far as the 22nd annulus, in the form of minute white tubercles, by no means prominent, as regards size, but standing out slightly against the surrounding body-surface, under detailed examination, as flattened structures of a purer white colour. The colour mentioned is no doubt due to the bleaching action of the corrosive sublimate, and, in all probability, the colouration of the papillæ themselves differs in no wise from that of the ordinary body-surface. They can be traced forwards as far as the 51st annulus from the posterior extremity, and serve in this way as the only external sign of the somitic constitution. Except at the posterior extremity, where abbreviation has taken place and the triannulate somite lost, they occur on every third annulus, each papilliferous annulus bearing four papillæ, two occurring on each side of the median line as shown in fig.9. The papilla on either side of the median line is much more prominent than that nearer the margin. The surface in general may be described as smooth. Total number of annuli about 70.

The disposition of the annuli, with reference to the somites, has been made out chiefly from a study of the sensory papillæ, of the position of the eyes, and the arrangement of the nerve-ganglia.

Somite i.	Annuli 1.	Constitution, Uniannulate.
,, ii.	,, 2.	,, Uniannulate.
,, iii. ⎫ ,, iv. ⎬ ,, v. ⎭	,, 3-8.	
,, vi.-xxiv.	,, 9-65.	,, Triannulate.
,, xxv.	,, 66, 67.	,, Biannulate.
,, xxvi.	,, 68, 69.	,, Biannulate.
,, xxvii.	,, 70.	,, Uniannulate.

The oral sucker is constituted by eight annuli, the eighth forming its lower lip. The mouth lies slightly anterior to the central point of the oral sucker, in the posterior region of somite iii. The posterior sucker, as in most species, is slightly longer than broad. The anus lies between the second and third last annuli.

In one specimen two pairs of eyes were made out, and in the other an unpaired eye(?) was present in addition to these. The paired eyes lie on the posterior region of annulus 5, and the anterior region of annulus 6; that is, in somites iv., and v., respectively. The unpaired eye(?) was made out to the right side of the median line, and lay partly on annuli 3 and 4. The first paired eyes which the unpaired eye represents(?) are evidently undergoing degeneration as regards pigmentation.

In the case of the specimen in which the eye in an unpaired condition was not seen, examination of sections failed to show any trace of an ocular structure in the position occupied by it in the other specimen. We may then take it as granted that the characteristic number for the species is four. It would seem probable, further, that the apparent ocular organ between annuli 3 and 4 is not in reality an eye, although much resembling the same, on external examination, as regards shape and pigmentation.

Digestive system.—In general this system bears close resemblance to that of *G. heteroclita* and *G. australiensis*. The mouth is situated in annulus 4, anterior to the mid-point of the oral sucker. The proboscis extends from the seventh postoral annulus to the 20th, that is, it extends through annuli 14-27, in its normal retracted condition, and constitutes fully one-third of the body in thickness. It measures about 2 mm. in length, passing into the œsophagus at about the position of the male genital aperture.

The œsophagus is short, extending through only two annuli, namely 28 and 29. In longitudinal vertical sections it is readily distinguishable from the crop by its much narrower lumen and the irregular folded nature of its epithelium, grading, as it does, from the proboscideal nature to that of the crop, and differing markedly from the proboscis by the absence of the strong circular muscular fibres so abundantly developed in the latter, and, in general, by the more feebly developed musculature. The proboscis and œsophagus lie in somites vii.-xii.

The crop bears six pairs of cæca, a pair arising behind each pair of testes, and thus occurring in somites xiv.-xix. The last pair are long and lobed, as in *G. heteroclita*, thus differing from the simple unlobed cæca of *G. stagnalis*, *G. fusca*, and *G. parasitica*, to which in other respects it is so closely allied.

The stomach is provided with four pairs of auricular sacs which are found to lie in somites xix.-xxii., the first pair really arising in somite xx., but extending forwards into xix., and, as in the case of the crop-cæca, representing an originally metameric arrangement.

Reproductive organs.—There are six pairs of testes in most species of *Glossiphonia*. They lie in annuli 32, 33, 34; 35, 36, 37; 38, 39; 41, 42; 44, 45; 47, 48. Three annuli thus intervene between the anterior limit of any one testis and the anterior limit of the next, and all are found to lie intersegmentally in the following somites $\frac{\text{xiii.}}{\text{xiv.}}$, $\frac{\text{xiv.}}{\text{xv.}}$, $\frac{\text{xv.}}{\text{xvi.}}$, $\frac{\text{xvi.}}{\text{xvii.}}$, $\frac{\text{xvii.}}{\text{xviii.}}$, $\frac{\text{xviii.}}{\text{xix.}}$ as in species of *Glossiphonia* in general. The regularity about this intersegmental position of the testes enables one to use it as a ready means of checking the somites in sections of the organism.

The ovaries lie in the usual position, as two unequal sacs, one extending backwards to about annulus 46(somite xviii.), and the other to about annulus 42(somite xvii.).

The genital ducts call for no special remarks. The genital apertures are separated by a single annulus. The male pore lies between annuli 27, 28 (20th and 21st postoral annuli), and the female pore between 28, 29 (21st and 22nd postoral annuli). From an examination of fig.8, showing the metameric constitution of the animal, it will be seen that the male pore lies between the 1st and 2nd, the female pore between the 2nd and 3rd annuli of somite xii. In this connection I would remark that it would be preferable if all workers at the group stated the position of the genital apertures definitely in terms of the postoral annuli, inasmuch as their exact position is an important point; and, it seems to me, many mistakes are liable to creep in, in stating their position in terms of the anterior annuli in an absolute way. The position of the genital pores in somite xii., agrees in detail with that in *G. stagnalis*, *G. fusca*, and *G. elongata*; and that of the male pore alone with the similar aperture in *G. heteroclita.*

In connection with the position of the genital apertures, lies something of phylogenetic interest, particularly so as one can, I think, make out the primitive condition with some accuracy in regard to the genital apertures. Taking, firstly, into consideration the commoner European and North American species, one finds the arrangement of the apertures to be as follows :—

G. complanata...		apertures
G. concolor.......	♂ between annuli o somites xi.,xii.	separated
G. parasitica....	♀ between annuli 2 and 3, somite xii.	by two
G. elegans.........		annuli.
G.. heteroclita....	♂ ♀ united, between annuli 1 and 2, somite xii.	
G. stagnalis		apertures
G. fusca..........	♂ between annuli 1 and 2, somite xii.	separated
G. elongata	♀ between annuli 2 and 3, somite xii.	by one
G. intermedia...		annulus.

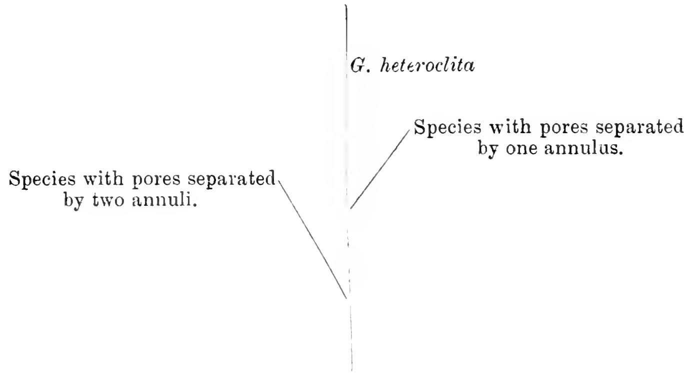
From the central position occupied by *G. heteroclita,* with regard to the other species, not only in connection with the genital apertures, but also numerous other characters; and taking into consideration the fact that the positions of the apertures in the three groups given above, into which the species fall, one may conclude that the genital apertures are in their primitive position, in regard to the genus, in somites xi.-xii. Castle has already considered the species from a phylogenetic standpoint, and has placed *G. heteroclita* on the central stem. From the above table it will be seen that *G. stagnalis*, *G. fusca*, and *G. elongata*, in connection with the genital apertures, have the male pore in the same position as that of *G. heteroclita*, and the female pore in the same position as that of *G. complanata*, *G. concolor*, *G. parasitica*, and *G. elegans*. Were the genital apertures, under primitive conditions, united or separate? If separated, how many annuli lay between them?

Nothing in this connection, so far as I know, can be deduced on recapitulatory lines from our knowledge of the development of the genus, in regard to the positions of the genital pores.

All members of the Hirudinea are hermaphroditic, and beyond one or two(?) species of Glossiphonia (*G. heteroclita*) and the genus *Semilageneta*, the sexual pores are separated by a number of annuli, which number is frequently in accord with that of the annuli composing a somite. In the *Glossiphoniidæ* there is no trace of a penis, as is found in many other leeches, and mutual impregnation, as seen in other leeches, is very likely not possible among the members of this group. This idea I draw from the interesting fact noted by Whitman, that hypodermic impregnation obtains in *G. parasitica*, and most likely in all species of the genus; and, further, that no species (and many have been studied attentively in freshwater aquaria, in various parts of the world) has ever been seen to copulate, as do many other leeches. In addition, the structure of the genital apparatus would seem to strengthen this idea.

From a study of the Hirudinea in general, it would seem logical to conclude that the separation of the genital apertures is really correlated with the possibility of mutual impregnation. An interesting fact can be noted, in that all members of the genus from any part of the world—and most large regions have some endemic species—fall into two groups, one of which has the apertures separated by one annulus, the other being characterised by the presence of two annuli between the pores.

From the above data I conclude that the primitive stock from which the Glossiphonid forms were derived, was originally provided with a penial structure, and that the genital apertures were separated by a number of annuli, the pores being situated probably in successive somites.



Castle's elaborate and complete studies on the anatomy of the North American *Rhynchobdellidæ*, render it possible to construct a phylogenetic tree, showing the position of the species in regard to one another; and the above is, in the main, in agreement with his conclusions on fundamental grounds. The study of the position of the genital pores enables one to decide the points at which the two side-groups left the central stem. There has been a stimulus urging the approach of the genital apertures. In the *concolor*-group we see a much nearer approach to other leeches in general in regard to the position of the pores, this group leaving the main stem, and being characterised by (1) three pairs of eyes, (2) seven pairs of lobed crop-diverticula, (3) a rough papilliferous integument, (4) asymmetrically arranged egg-clusters, and (5) genital apertures separated by two annuli. Before this group had left the main stem, sufficient time had probably elapsed to permit of the shifting back of the male pore so that it now lay between somites xi. and xii., instead of being situated further forward in somite xi.(very probably between annuli 2 and 3 of somite xi.). Along the main stem there had been a further shifting backwards of the male pore, until it came to lie between annuli 1 and 2 of somite xii. At this stage the *stagnalis*-group would seem to have left the main stem. No further moving backwards of the male pore seems to have then resulted in a moving forwards of the female pore in forms situated on the main stem, the examples of these conditions being represented in *G. heteroclita.* The *stagnalis*-group, after leaving the main stem, developed the following characters—(1) a single pair of eyes, (2) crop-diverticula simple, never exceeding six pairs, (3) a smooth integument, (4) egg-clusters arranged in two longitudinal rows, and (5) genital apertures separated by one annulus (this character probably having developed much earlier).

Glossiphonia heteroclita(?).

The occurrence of this now universally distributed species in Australia, is not unexpected. In the first examination of *G. australiensis* mihi, I was strongly inclined to regard that form as a variety of *G. heteroclita*, but ultimately came to the conclusion that I was dealing with quite a different species. That form is very large, when compared with *G. heteroclita*, and, having now had the opportunity of examining the latter form, I am convinced that *G. australiensis* is entitled to new specific rank. *G. heteroclita* is abundant in Europe and North America.

The single individual representative of this species was obtained at Narara Creek, in the Gosford district. It was found adhering to a piece of floating timber, and evidently was not abundant in that particular spot, as I failed to obtain other specimens after several hours' search. The creek had been in flood a few weeks before, and the leech may, as a result of this, have been transported on the timber from the upper reaches of the stream. No freshwater mollusca were found, but small native perch were abundant, and very possibly the latter may serve as a host for the species.

External characters—The body is clear and gelatinous like the substance of a Medusa or jelly-fish, the crop, with its cæca, showing through the clear body-substance as yellowish-brown structures; it is the presence of these coloured structures that draws the attention of a collector who, otherwise, would recognise nothing in the clear body-mass to consider the presence of a leech. On being placed in a solution of corrosive sublimate, the body became white and opaque, the characteristic features of a leech becoming more evident. No pigment-areas or any traces of structures of metameric significance, such as sometimes occur in *G. heteroclita*, were visible. Length 8·8(contracted specimen); breadth 2·6 mm. (contracted specimen). Annuli 68-72; very inconspicuous in the preserved specimen (much more so in the living condition) except towards the lateral regions of the body. The skin is quite smooth and devoid of any sense-papillæ.

Eyes.—Three pairs of eyes are present, arranged in the form of an arc. The anterior pair are small, and lie close together on the posterior border of annulus 4. The second pair are widely separated, very large, and lie on the posterior portion of annulus 5 and the anterior portion of annulus 6. The third pair are equal in size to the second pair, and lie in close apposition to them, in the posterior region of annulus 6.

Limnobdella australis.

Hirudo australis Bosisto, 1857; *Hirudo quinquestriata* Schmarda, 1861; *Limnobdella quinquestriata* Kershaw, 1904; *Hirudo novemstriata* Grube, 1866.

This species is the commonest of our New South Wales leeches, occurring abundantly in freshwater creeks and moist places throughout the State, and extending its region of occurrence into Victoria and Queensland. It has a keen biting habit, and, in this connection, it is a source of much annoyance in bush travelling. This is due to the large strong teeth borne in the three jaws. This leech is stocked by chemists, and replaces here admirably the Medicinal Leech, *H. medicinalis*, of Europe.

Beyond the meagre descriptions of Bosisto, Becker, and Schmarda, in addition to a few diagrams in Parker and Haswell's "Text-Book," but little is known of this species.

Bosisto described the form under the name *Hirudo australis*, in 1857; Schmarda described a form under the name *H. quinquestriata*, and this name has been upheld to the present time.

Grube has recognised these as synonyms, and his conclusions I can verify by the examinations I have made of a large number of individuals. Bosisto's name consequently has priority.

I must here express my indebtedness to Mr. Thomas Steel, for having placed at my disposal a number of specially interesting individuals, the privileged examination of which has assisted me much in the study of this form, and the determination of synonyms.

In 1904, Kershaw mentions the occurrence of a freshwater leech, *Limnobdella quinquestriata*, at Launching Place, Yarra, Victoria. This is none other than our common freshwater form.

Blanchard, in 1893, proposed the generic name, *Limnobdella*, to include certain species known until then as species of *Hirudo* (and amongst these he mentions *H. quinquestriata*), and the characters of the genus he lays down in the following diagnosis: "Corpus, oculi, porique genitales dispositi ut in Hirudine. Somitus xxiii.$^{\text{tius}}$ e 5 annulis completis constat, ut in Macrobdella et in Whitmania; a prima vero hoc differt quod glandulæ copulationis deficiunt, ab altera quod somitus vi.$^{\text{tus}}$ solummodo e 3 annulis constat. Maxillæ paucis, longis vero fortibusque dentibus armatæ."

Undoubtedly the species under consideration finds its place in the genus *Limnobdella*, and is then to be known as *L. australis*.

Recently Professor Benham described under a new specific title a New Zealand species of *Hirudo*. This form approaches so closely to *Limnobdella australis*, from the standpoints of internal and external anatomy, that I am strongly inclined to regard them as one and the same species, the New Zealand form, *H. mauiana*, representing a well marked variety (as Professor Benham thought might be the case) of *Limnobdella australis*.

Becker's diagrams give a much better idea of the general appearance of our species than does that of Schmarda.

With a view to settling this point (Professor Benham not having specimens of our form), and also fixing the anatomy of *Limnobdella australis*, I have attempted some work in that connection.

I might also mention that Grube has described a form under the name *Hirudo novemstriata*, from Rockhampton(New Holland), and this no doubt is identical with *Limnobdella australis*. Leaving out of consideration the extreme lateral marginal regions, we get really nine different coloured regions, and, no doubt, this was the colouration-character that Grube described as "novem-striata."

Colouration.—Mr. Steel's specimens resemble in dimensions those of *Hirudo mauiana*, but approach almost exactly Schmarda's diagram as regards pattern. These specimens had been killed in an excellently extended condition, and preserved in a very suitable manner for external examination in the same manner as that recommended for land-planarians. The specimens obtainable from chemists in Sydney approach much more closely to Benham's *H. mauiana*, in regard to the greater importance of the median pigment-band, and also the relatively greater importance of the dark pigment-bands. At the same time, these specimens show a much greater development as regards thickness and breadth. This difference, however, is very readily explained as being due to distension by blood and also to contraction.

Becker's diagrams give a much better representation of the leech than does that of Schmarda, the latter showing the individual in a thoroughly extended condition.

The measurement given by Grube for the posterior sucker far exceeds the normal size, the measurement in the large number of specimens I have examined being very seldom more than 6 mm. and frequently less. Schmarda's diagram, from a general standpoint, is misleading. One finds some (but very few) specimens which are ornamented, in regard to the dorsal linear pigment areas, in the proportion denoted in Schmarda's figure. On the other hand, the great majority of individuals which I have examined, show a dorsal median pigment-line of much greater importance. In a very large number this approaches very close in importance to the pigment lines on either side, and in some cases actually outstrips these lines.

This variation is to be noted in individuals collected in different regions, and is to be regarded as a "local variation." In none, however, do these lines approach the great importance of development as seen in Benham's *H. mauiana.* However, I cannot think that these practically small differences in connection with colour-pattern are to be taken so seriously as to be considered a character warranting the institution of a new specific name; rather is it to be more readily understood as a "local variation."

The close agreement in anatomy seems to place it beyond doubt that we have, in New South Wales and New Zealand, one and the same species. We find, in the case of *Hirudo medicinalis,* enormous variations as regards details in connection with colouration, but yet all these conform to a general pattern as do *Limnobdella australis* and *Hirudo mauiana,* and consequently, for the latter, I would propose the name *Limnobdella australis* var. *mauiensis.*

Below are shown the measurements of a number of specimens selected as giving the average in regard to the means and extremes.

Length 64·5 mm.	Breadth 9·5 mm.	Posterior sucker 5 mm.
,, 64·5	,, 9	,, 5
,, 76	,, 11	,, 8
,, 68	,, 8·5	,, 5
,, 76	,, 8·5	,, 6·5
,, 66	,, 10	,, 7
,, 71	,, 11	,, 9
,, 76	,, 3·6	,, 4

The measurements given above were made on preserved specimens, and represent just a few among a great number of measurements. Comparing them with Grube's measurements, it will be seen that they differ for any given length in respect to the breadth and the diameter of the posterior sucker; and it will also be seen that they approach much more closely to Benham's species than to *Hirudo australis* of Schmarda.

	Length.	Breadth.	Posterior sucker
Hirudo australis Schmarda	72 mm.	16 mm.	10 mm.
Hirudo mauiana Benham	70	5	4·5
Limnobdella australis mihi	68	8·5	5

The total number of annuli is 102, as in species of *Hirudo* and *Limnobdella* in general.

As there are no traces of sensory papillæ on the surface, I have attempted, by means of the positions occupied by the nerve-ganglia, to map out the somitic constitution of the animal, taking also into account the assistance given by the position of the eyes, taking for granted that, especially in the middle region of the body, the nerve-ganglion lies in the middle annulus of a somite, and that abbreviation has taken place at either extremity according to the set plan laid down by Castle's observations.

Somite	i.	Annuli	1.	Nature,	Uniannulate.
,,	ii.	,,	2.	,,	Uniannulate.
,,	iii.	,,	3, 4.	,,	Biannulate.
,,	iv.	,,	5, 6.	,,	Biannulate.
,,	v.	,,	7, 8, 9.	,,	Triannulate.
,,	vi.	,,	10, 11, 12.	,,	Triannulate.
,,	vii.	,,	13, 14, 15, 16.	,,	Tetrannulate.
,,	viii.-xxiii.	,,	17......96.	,,	Pentannulate.
,,	xxiv.	,,	97, 98.	,,	Biannulate.
,,	xxv.	,,	99, 100.	,,	Biannulate.
,,	xxvi.	,,	101, 102.	,,	Biannulate.

Note that, in the newly arranged diagram showing somite-constitution, annuli 5,6 and 7,8 show fusion on the ventral aspect. This is of interest, inasmuch as it may very reasonably be construed as signifying that the fused annuli belong to one and the same somite. As we find that the number of somites (33) is constant among the Hirudinea in general, it is much more reasonable to conclude that, when abbreviation or extension of the annuli takes place, this is a matter affecting the somite concerned alone.

In this connection it is noticeable that annuli 5 and 6 show signs of fusion (complete on the ventral aspect), and that these are determined as belonging to and really constituting somite iv. Again, we find annuli 7 and 8, which represent the first two annuli of somite v.(triannulate), are fused on the ventral aspect. In the case of somite iv., the first annulus has evidently disappeared by fusion with annulus 5, which represents the middle annulus of the originally pentannulate, and later triannulate somite; and is oculiferous. In the case of somite v., we find that abbreviation has not taken place to such an extent as in iv., but still it is the first annulus, namely 7, which is showing signs of fusion with the middle constituent of this somewhat abbreviated (triannulate) somite.

This is admirably in keeping with the generalisations made by Castle for the Hirudinea in the matter of somite-extension or abbreviation.

Benham mentions, in his account of *Hirudo mauiana*, that annuli 5 and 6 are fused.

Somite vii. is tetrannulate, the first annulus of the originally pentannulate somite having disappeared, and the somite approaching the condition of somites v. and vi., or that the perhaps more primitive triannulate somite has added an annulus in its posterior region and not in its anterior region.

The order of abbreviation would then appear to be as follows :

Annulus.	Ann.	Ann.	Ann.	Ann.
1	2	3	4	5
(*a*)	(*c*)		(*d*)	(*b*)

Nephridiopores.—Nephridia do not occur in other than tetrannulate or pentannulate somites. The first pair of nephridiopores lie on the first annulus (near its posterior margin) of somite vii., that is, annulus 13. In contracted specimens the nephridiopores would appear to open between two annuli—the annulus bearing it and the succeeding one. The remaining sixteen pairs of nephridiopores lie on the posterior margins of the second annuli of the pentannulate somites viii.-xxiii: that is, they lie on annuli 18,23,28,33,38,43,48,53,58,63,68,73,78,83,88,93.

The eyes occupy the positions characteristic of the genera *Hirudo* and *Limnobdella*, namely, on annuli 1, 2, 3, 5, and 8.

There are present no sensory papillæ on the surface, as in *H. medicinalis*, so that, beyond the assistance given by the five pairs of eyes at the anterior extremity, one has to rely on the nephridiopores and nerve-ganglia. By passing fine needles through these ganglia and the ventral body-wall, I was enabled to make out definitely the relationship of the nerve-ganglia to somite-extent and constitution.

The lower lip is formed by annuli 5 and 6, which, as mentioned above, are fused on the ventral aspect. A similar state of affairs obtains in the case of *Hirudo mauiana*.

The genital apertures occur in the usual position for members of the genera *Hirudo* and *Limnobdella*. The male aperture is to be seen, as a prominent slit, on the 30th annulus, at about the anterior limit of its posterior third. Counting the postoral annuli, it is observed to lie on the apparent 24th annulus seen on the ventral side, but this is, in reality, the 26th postoral annulus, owing to the fusion ventrally of annuli 5,6, and 7,8 respectively. Evidently the annuli are similarly fused in the case of *H. mauiana*, as Benham states that the male aperture lies on annulus 30, or on the posterior limits of the 24th postoral annulus, annuli 5 and 6 being fused to form the lower lip. Such could not be the case were two other annuli not also fused ventrally, and these, in all probability, are annuli 7 and 8, what he calls the 24th postoral annuli being, in reality, the 26th postoral annulus. This is another point of agreement externally between *H. mauiana* and *L. australis*.

The female genital pore lies between annuli 35 and 36, that is postoral annuli 31 and 32, or, counting only the annuli which can be made out on the ventral surface, the 29th and 30th apparent postoral annuli.

The jaws are crescentic in outline in their teeth-bearing portion. The teeth are 48-50 in number, and are very long and strong. Their number and nature are excellently described in the portion of Blanchard's diagnosis bearing on that subject as "Maxillæ paucis, longis vero fortibusque dentibus armatæ." The arrangement and nature of the teeth may be seen in fig. 10.

The only internal structures which call for any special remark, are the reproductive organs.

The testes lie in the last annular region of somites xii.-xxi., that is, in the second annulus behind the nerve-ganglia of these pentannulate somites. There are present ten pairs, as in most species of *Hirudo*. In *H. medicinalis* there are nine pairs normally present, but occasionally one finds ten pairs. In Parker and Haswell's diagrams there are only nine pairs represented in connection with *H. quinquestriata*. It is quite possible that nine pairs may sometimes be present in our form, although I have dissected a large number of specimens, and have never reckoned less than ten pairs. At first I imagined that, very possibly, if *H. australis* and *H. quinquestriata* were not synonymous, that the former might possess nine pairs and the latter ten pairs. However, such I am sure is not the case, and, as it is well nigh impossible that one would miss one pair when making a count of such conspicuous organs in a dissection, it seems very possible that nine pairs only are present as an occasional variation in *Limnobdella australis*.

Benham notes the presence of ten pairs in *H. mauiana*, and only seven pairs in *H. antipodum*.

In consideration of these facts, it would seem that we must regard the genus *Hirudo* as being originally provided with ten pairs of testes, and that this number has later shown a tendency towards reduction. It is apparently the last pair of testes, as represented in *Limnobdella australis*, which is generally absent in *Hirudo medicinalis*.

The ovaries agree in nature with those of other species, and call for no special remark.

The male apparatus agrees with that of *H. mauiana*, in having a strong muscular sac between the anterior extremity of the seminal vesicle and the "prostate." The vasa deferentia pass along the outer side of the testes, with which they are connected by a delicate vas efferens in the last annulus of each testigerous somite. Anteriorly each vas deferens passes into a densely convoluted whitish mass, epididymis, which is connected with a large highly muscular sac, ovoid in shape, directed inwards and forwards. As in *H. mauiana*, this corresponds to the "ductus ejaculatorius" of *H. medicinalis*. From each of these muscular sacs a duct passes inwards at right angles to the long axis of the body, and these ducts open as usually into the median globular prostate, from which a long curved penis-sac passes backwards and afterwards forwards, to open at the male pore, behind the sixth ganglion. This agrees in detail with that described by Benham for *H. mauiana*. The female apparatus also agrees in detail with that of *H. mauiana*, the two small ovarian sacs leading by narrow oviducts into an albumen-gland connected with a uterus, which passes forwards and ventrally into a vagina, surrounded by distinct circular muscles, as described by Benham for *H. mauiana*.

Remarks.—If *H. mauiana* and *L. australis* are not to be regarded as one and the same species, it cannot be denied that they are very closely allied species; and the same interest in their distribution obtains, whether one be regarded as a variety of the other, or as a distinct species. Each form is a true endemic representative in either country, in every possibility. The most interesting point is bound up in the characteristic structure of the genital organs, and this character may be possibly an anatomical feature to be found among those forms which Blanchard would place in his genus *Limnobdella*, in contradistinction to that to be found in *Hirudo* (in its narrow sense).

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EXPLANATION OF PLATES XLV.-XLVI.

alb., albumen-gland—*cr.s.*, crop cæcum—*ep.*, epididymis—*ms.s.*, muscular sac (ductus ejaculatorius)—*int.*, intestine—*ne.*, nephridiopore—*ovd.*, oviduct—*œ.*, œsophagus—*pa.*, sensory papilla—*prs.*, prostate glands—*pr.*, proboscis—*pr.sc.*, proboscis-sac—*pn.sc.*, penis-sac—*st.sc.*, stomach-sac—*te.*, testis—*ut.*, uterus—*v.d.*, vas deferens—*vg.*, vagina—*ov.*, ovary.

Plate xlv.

Fig.1.—*Glossiphonia intermedia*, sp.n.; ventral view showing arrangement of the eggs.

Fig.2.—Diagrams showing relative positions of the sexual pores in species of *Glossiphonia*.

Fig.3.—*Limnobdella australis*: male organs.

Fig.4.—*L. australis*: female organs.

Fig.5.—*L. australis*: diagram showing fusion of annuli 5 and 6, 7 and 8.

Fig.6.—*G. intermedia*, sp.n.: diagram showing position of the eyes.

Plate xlvi.

Fig.7.—*L. australis*: anterior region showing somitic constitution.

Fig.8.—*G. intermedia*: diagram showing positions of organs (left half ventral, right half dorsal), and somitic constitution.

Fig.9.—*G. intermedia*: diagram showing arrangement of papillæ.

Fig.10.—*L. australis*: jaw.

Fig.11.—*G. intermedia*: posterior extremity, showing abbreviation of the somites.

Fig.12.—*L. australis*: diagram showing position of testes.

AUSTRALIAN FRESHWATER POLYZOA. Part i.

By E. J. Goddard, B.A., B.Sc., Linnean Macleay Fellow of the Society in Zoology.

(Plate xlvii.)

The present paper deals with an account of the known freshwater Polyzoa of Australasia, and a description of a new species of *Fredericella.*

Practically nothing has been attempted in connection with this portion of our freshwater fauna since the work of Macgillivray, Whitelegge, and Hamilton, which was done at least twenty years ago.

An examination of Whitelegge's "Invertebrate Fauna of Port Jackson and Neighbourhood" shows that among the seven members of the *Phylactolæmata* which he collected, there was no species which he could then refer to known forms except *Plumatella Aplinii* and *Lophopus Lendenfeldi*, both of which were confined to Australia. Since then we have found the common European species, *Plumatella repens*, in abundance in Queensland, New South Wales, and South Australia; also in New Zealand; and *Paludicella ehrenbergii* in New Zealand.

Whitelegge records a species of *Fredericella* which he remarks on as being closely allied to *F. sultana*, but differing from it in the shape of the statoblasts, which are "nearly round and not bean-shaped." Beyond this record there is no published mention of *Fredericella* from Australia, except in the "Cambridge Natural History," this latter mention being, no doubt, due to Whitelegge's record. This species has been found in abundance since in New South Wales, especially in connection with our water-supply, where it causes the same trouble as in the water-mains of other countries. For the material which I have been privileged to examine, I am indebted to Dr. Stokes.

Mr. — Bradley, of Adelaide, who has spent some time in collecting and examining the freshwater forms of South Australia, informs me that *Plumatella repens* and *Fredericella sultana* are abundantly represented in that State; but I have no doubt that the latter species is wrongly named, and is none other than the species, originally found by Whitelegge, which certainly bears a very close resemblance to *F. sultana*, and might readily be confused as a mere variety of that form. However, considering that it differs from *F. sultana* in the shape of the statoblasts and the number of the tentacles, in no small measure it seems worthy of a new specific name.

Dendy has also recorded *Fredericella sultana*(?) from New Zealand.

Species of *Plumatella* occur in New South Wales, which, judging from the character of the statoblasts, differ from any known species. It is deemed advisable, however, to refrain from creating species on this information, until one has had the opportunity of examining the whole colony, especially so as this particular genus offers great difficulties in connection with the making of good species, inasmuch as variation takes place to such an extent that it would appear that many so-called species are no doubt mere varieties.

Mr. A. McCulloch, of the Australian Museum, found in the Nepean River, a mass of Polyzoa growing on a submerged stick; and, judging from the nature of the statoblasts, we have in this a new form; but unfortunately I have no material at present available.

It will be seen from the above remarks that there is plenty of room for investigation in connection with our Phylactolæmata, and I am assured that a systematic search will prove very profitable, with a view to a further knowledge of the forms represented in our fresh waters, and the distribution of freshwater Polyzoa in general.

FREDERICELLA AUSTRALIENSIS, sp.n.

This species occurs abundantly in connection with our water-supply at Pott's Hill, and probably represents the only definitely known species other than the common European and North American species, *F. sultana* and *F. cunningtoni* from Lake Tanganyika. Several other species have been proposed but have been proved to be identical with *F. sultana.*

Davenport has given the following amended diagnosis for the genus :—" Stock branched in the form of antlers; more rarely massed with recumbent and elevated tubes; mostly brown or incrusted with algæ and grains of sand; rarely hyaline. Tubes cylindrical, the older ones mostly keeled. Without complete dissepiments. Apertures terminal at the broadened or bifid ends of tubes. Polypide very long and slender; tentacles arranged in a nearly circular corona. Few tentacles, not exceeding 24. Statoblasts dark brown, bean-shaped or elliptical, without float, and with smooth upper surface."

The above diagnosis has removed from the list of species, as synonyms of *F. sultana*, the following forms : *F. walcottii* Hyatt (1868); *F. pulcherrima* Hyatt(1868), and *F. regina* Leidy.

The only other species known are *F. du plessisi* Forel(1900), from Lake Geneva, the characters given for which form I cannot ascertain, and *F. cunningtoni.* As has been previously hinted in this account, the Australian species of *Fredericella* has been commonly regarded as being identical with *F. sultana;* and, as such, has been noted in Davenport's account in connection with the distribution of that North American and European species, the nature of the statoblast, when this character alone is considered, being such as to well and easily permit of the Australian form falling within the limits of the characters given for the genus *Fredericella* by Davenport, or, in other words, for the then only recognized species, *F. sultana.* It is certainly known that variation does take place in regard to the nature of the statoblasts, and this has been understood sufficiently well to enable the description of them to be " bean-shaped or elliptical " in place of Allman's "bean-shaped." No statoblasts, however, which I have examined, resemble those shown by Allman, as representing these structures in *F. sultana*; and what variation has been noted has been very slight in any way approaching those of *F. sultana*. Variation in the shape of these structures can be seen in various directions in the statoblasts found in the same portion of a colony of *F. australiensis*, but rather towards an ovate appearance.

Diagnosis.—Young form closely adherent and branched; older colonies detached in younger parts; polypides seen only at the ends of filaments. Tubes not cylindrical, brown; tentacles 28-30, arranged in an elliptical corona; lophophore horseshoe-shaped in retracted condition. Not keeled, and devoid of dissepiments.

Statoblasts few in number, brown or black; broad elliptical, slightly ovate, or very slightly flattened on one side parallel to longer axis of the ellipse.

The chitin composing the ectocyst is about 0·003 mm. in thickness, and is quite clear when examined in section. It is always covered externally by a material of equal or greater thickness, consisting of a brownish matrix, abundantly scattered through which are the frustules of diatoms, etc. The stems of the colony appear in section as roughly triangular, in a great number of instances having the form of an equilateral triangle. At first, I was inclined to regard this as being due to lateral pressure in the process of sectioning the chitin, but the regularity of the occurrence and of the form itself, and contrast with the chitinous portion containing the polypide seems to disprove this. In this way we probably have another point of difference between this species and *F. sultana*, in which the tubes are cylindrical, the older ones keeled on one side. No traces of dissepiments (usually found, in an incomplete state, in *F. sultana*) can be seen in this species, near the commencement of branches or elsewhere.

The lophophore is not circular, like that of *F. sultana*, but elliptical. The tentacles, 28-30 in number, are towards the base united by a tentacular membrane, and cross-sections in this region measure 0·38 mm. in length, and 0·23 mm. in breadth. The tentacles are about 1 mm. in length, and 0·01 mm. in diameter, these very slender structures rendering a graceful appearance to the animal. The lumen is about equal in diameter to the large cells composing the wall. These cells are square in shape, as seen in transverse section; and contain a large, deeply staining, centrally placed nucleus, about 5 or 6 of the cells encircling the lumen. They bear a strong resemblance to those lining the epistome. When the tentacles are retracted, it is seen in section that the lophophore is no longer elliptical in shape, but has been invaginated on the anal side so that two horns of it project on either side of the epistome; and this gives, in section, an appearance similar to that which exists among other members of the *Phylactolæmata, e.g., Lophopus, Cristatella*, etc. This point has, perhaps, some little interest in this respect, inasmuch as *Fredericella* is unique among the members of the *Phylactolæmata* in having a lophophore which is circular or elliptical, and not horseshoe-shaped, and bridges over the gap in this direction between *Fredericella* and other genera, the folding, which one might on other grounds treat as being of no value, occurring in such a way that it agrees exactly as regards its detailed direction with the other genera. In counting the tentacles, use was made of transverse sections, so that no error could be made in this reckoning which is very difficult and unreliable if one used ordinary entire mounts of killed specimens. The epistome is a bluntly rounded tongue-like process, about 0·09 mm. in length. As seen in transverse section, it is oblongate-elliptical, with a slight concavity on the anal side, giving it a faint reniform contour. These sections measure 0·07 mm. in a line at right angles to the axis joining mouth and anus, and 0·016 mm. along that axis itself. The organ is thus seen to be flap-like in nature Its wall consists of large columnar or squarish cells, with centrally situated nuclei, the limits of which, like the cells of the tentacles, which they much resemble, being readily made out. These cells constitute the wall in its entirety, no muscular layers, etc., being visible.

The œsophagus is about 0·3 mm. in length, and varies much in shape according to the condition of the polypide. In good extension it is of an hourglass-shape; when partly extended it is an attenuated cylindrical tube; well withdrawn, it passes from a swollen cylindrical form into that of a cone, whose base is at the oral extremity, according as the retraction is partial or complete. It passes into the stomach, into which it is continued as a valve-like structure, which, although plainly visible in the perfectly extended polypide, is best shown under a certain amount of retraction. In transverse section it is circular, measuring, in the region between the mouth and anus, about 0·55 mm. in diameter; and in this protrusible portion of the polypide, constitutes the greater part of a section. It is lined by a layer of columnar cells with centrally situated nuclei, the height being about $2\frac{1}{2}$-3 times the breadth. The cells are provided with long flagella in the part of the œsophagus lying between the mouth and the anus. Below this region no flagella are visible. Nearing the region of the stomach, the cells are much more compactly arranged, to pass into the lining layer of the stomach, and the nuclei are situated at the outer extremity of the cells. The œsophagus in this region has become more elliptical in shape.

The stomach and intestine are shown in figs. 2-4, in conditions of retraction and extension. The stomach is lined by cells, varying in shape in different regions, and with basally situated nuclei. At the oral end of the stomach, the lining cells are columnar; in the aboral region, the cells are clavate and columnar, and the wall has a sinuous contour. The cells lining the intestine are not so compactly arranged as in the stomach, and are cubical.

Nervous system.—A nerve-ganglion is present in close contact with the œsophagus on its anal side. It has a flattened reniform shape, and is inconspicuous in entire mounts. The cells composing it have a loose arrangement.

Reproductive organs.—No definite sexual organs were visible in the specimens examined.

Statoblasts.—Occurring in the same tube, one finds statoblasts quite different in shape and measurements. For instance, I have noted, in the same tube, statoblasts of which some are of a perfectly broad elliptical contour, some shading from this into an ovate appearance, some more elongate and approaching an ellipse, but slightly flattened on one side parallel to the longer axis, and then again some of an elongate but ovate nature. These can be seen in figs.7-11.

In Allman's Monograph the statoblasts have a distinct bean-shaped appearance, but specimens obtained in Europe and North America evidently have shown that these structures may be elliptical in form. Considering the great number of specimens examined and the limits of variation as regards shape in the well known species, the Australian species is quite distinct.

The animals were killed in a good state of extension by adding a dilute solution of formalin, about 2 %, gradually to the water, and the preservation was found to be good. For some reason the difficulty usually encountered in the cutting of chitinous structures was not met with in the sectioning of the organism, although no softening agent for chitin was used. The material was allowed to remain in molten hard paraffin (58°) over the bath for about one hour after passing through the various stages of embedding by the benzole method, and this probably facilitated the sectioning of the chitinous ectocyst. The method acted admirably for all the sections. Delafeld's hæmatoxylin was used for staining entire specimens, and was found to give much better detailed results than borax-carmine. The same stain was used for sections, with eosin as a counter stain.

I am indebted to Dr. Stokes, Medical Officer to the Board of Water Supply, for the following notes on the occurrence and habit of the species in connection with the water-supply reservoirs. He says—" It is found to grow luxuriously in the screening tank at Pott's Hill, near Rookwood, and also in the 72-inch main from the end of the lower canal to Pott's Hill. In the latter it is most abundant near the inlet into the pipe, forming dependent masses from the crown, as long as 18 inches. These resemble tangled locks of coarse brownish hair. I have not observed it in the open canal, although I am told it is found occasionally in such, beneath the shade of bridges and culverts. I have met with small pieces in water immediately leaving Prospect Reservoir. I assume that it will not flourish in such portions of the water-system where it is subjected to the direct influence of the sun's rays; and further, that its distribution in the pipe-line and screening tank is determined by its need for oxygen, which would be most abundant at the commencement of the pipe-line and where the water is again exposed to the air at the screening tank. I have no data to show the influence of pressure on the animal, but have found that it will live at a depth of 20-25 feet in the screening tank."

In its habits this species resembles *F. sultana*, which grows during the whole of the spring, summer, and autumn months, both in standing water and rivers, generally avoiding direct exposure to the daylight.

The following is a complete list of the forms recorded to date from Australasia :—

Victorella pavida Saville Kent.—This genus is represented by one species, found by Whitelegge in brackish water on a species of *Nitella* in company with a tube-dwelling rotifer, *Œcistes* sp., in Cook's River. As far as I am aware, this form has not been recorded since.

Lophopus Lendenfeldi Ridley.—This species was named from specimens obtained by Whitelegge (and not by Lendenfeld) from the stems of aquatic plants in Parramatta Park. This species has not been found outside New South Wales. It differs from *L. crystallinus* chiefly in the absence of terminal angles of the statoblast, and the knobbed form of the inner end of the endocyst. The tentacles are also far longer than those of *L. crystallinus*.

Paludicella ehrenbergii Van Beneden.—Hamilton has recorded this species from Dunedin, New Zealand.

Plumatella Aplinii Macgillivray.—This species has been recorded from Victoria and New South Wales, and is undoubtedly a well founded form. I think that this form has also been found in New Zealand.

Plumatella princeps Kraepelin (*P. emarginata* Allman, 1844; *P. repens* Van Beneden, 1848 *P. diffusa* Leidy, 1851.)—This species occurs abundantly in Queensland, New South Wales, and

South Australia, and has also been recorded from New Zealand. This distribution would seem to indicate that it occurs throughout Australasia, and completes its cosmopolitan occurrence.

Plumatella sp.—Other undescribed species have been known for some time from New South Wales.

Alcyonella sp.—Whitelegge has recorded a species whose statoblasts resemble those of *Plumatella fruticosa* in shape, and are much narrower than those of *A. fungosa.*

We have now represented in Australia six genera (including *Alcyonella*), comprising six named species, and several unnamed forms; and of these, three are definitely known as endemic species —*Plumatella Aplinii*, *Lophopus Lendenfeldi*, and *Fredericella australiensis.*

Dendy has noted the occurrence of a species of *Fredericella* at Christchurch, New Zealand, which he identified as *F. sultana*, remarking on the occurrence of the same species in Australia. He noted, however, that his specimen differed from that figured by Allman for *F. sultana* "in being more slender and in the suppression (complete or partial ?) of the ridge-like keel"; also that the epistome (whether due to contraction or not) was bluntly rounded at the apex. I am inclined to regard this form of epistome as being the natural condition of such in the extended condition, inasmuch as the same is found in the species described in this paper; and the New Zealand form agrees with this species in the characters given by Dendy as differentiated from *F. sultana.* Dendy has unfortunately not had the opportunity of examining the statoblasts, and has not made any remarks about dissepiments, both of which structures would be of much assistance in determining the New Zealand species. The number of tentacles is said to be "about twenty-two," and this character, evidently noted in the entire individual, is the only one which would prevent one, under our present knowledge of the species, from suggesting that the New Zealand species may be none other than *F. australiensis.*

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EXPLANATION OF PLATE XLVII.

Fredericella australiensis, sp.n.

Fig.1.—Portion of colony showing number and position of statoblasts in a relative fashion.

Fig.2.—Digestive system partly retracted : *œ.*, œsophagus.

Fig.3.—Same completely extended : *rc.*, intestine.

Fig.4.—Same completely retracted.

Fig.5.—Section through tentacle-region, showing shape of lophophore in retracted condition (diagrammatic).

Fig.6.—Same in extended condition : *ep.*, epistome; *œ.*, mouth.

Figs.7-11.—Statoblasts.

Fig.12.—Camera lucida drawing of a polypide. Only 24 tentacles are epresented instead of 28.

WEDNESDAY, SEPTEMBER 29TH, 1909.

A Special General Meeting, together with the Ordinary Monthly Meeting of the Society, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, September 29th, 1909.

Mr. C. Hedley, F.L.S., President, in the Chair.

SPECIAL GENERAL MEETING.

Business: to consider certain consequential alterations in Rules xvi., xxi., and xxiii., specified below, which, by an oversight, were not formally made when Rules xlv., xlvi., and lix, having reference to the election of Auditor, were amended last year.

On the motion of Mr. J. H. Campbell, Hon. Treasurer, seconded by Mr. H. J. Carter, it was resolved, That (1) in Rule xvi.(last two lines)—*the words*—the name of a Public Accountant actively practising his profession, not a Member of the Society, recommended for election as Auditor: *be substituted for the words*—"the names of two Members," &c; (2) in Rule xxi.(lines 4-5)—*the words*—more than one: *be substituted for the words*—"a greater number than two [for the office of Auditor]"; and (3) that in Rule xxi.(last line) and Rule xxiii.(last line)—*the word*—Auditor: *be substituted for* "Auditors."

The President announced that a Special General Meeting would be held on Wednesday, 24th November, 1909, before the Monthly Meeting to be held on the same date. *Business*: to confirm the amendment of Rules xvi., xxi., and xxiii.[*supra*].

ORDINARY MONTHLY MEETING.

Dr. Cuthbert Hall, Parramatta, was elected a Member of the Society.

The President announced that the Council had to thank Professor David for a very kind offer to deliver a lecture to the Society on the Scientific Results of the British Antarctic Expedition, 1907, on some date, yet to be fixed, in the early part of November. Further particulars would be given at next Meeting.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 29 Vols., 72 Parts or Nos., 21 Bulletins, 5 Reports, and 19 Pamphlets, received from 59 Societies, &c., and two Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. D. G. Stead exhibited, alive, a number of a remarkable fantailed variety of the common Golden Carp(*Carassius auratus*), recently brought from Japan. The specimens shown, every one of which was slightly different from the others, were of the kind known to the Japanese as "Ranchu" or "Shishigashira" (literally "Lion-headed") sometimes known as the "Corean Goldfish." They are remarkable in that the dorsal fin has, by artificial breeding, been entirely done away with. One specimen shown had two anal fins. Mr. Stead also showed a living specimen of the remarkable amphibious fish, *Anabas scandens*, the "Climbing Perch," from Singapore. This is the first record of the importation of the species into New South Wales.

Mr. Froggatt exhibited a very fine and representative collection of Coleoptera recently obtained by him in the Solomon Islands; and he pointed out the most characteristic forms.

Mr. Lucas exhibited a number of Sea Balls, forwarded by Mr. G. H. Halligan from Port Stephens in July. Some were globular, others oval or elongated, and some flattened like a mango fruit. The forms, indeed, recall those of waterworn pebbles. They vary in size, the largest being 3¼ inches in length. They consist of a compact solid felt of closely woven fibres, which do not swell up when soaked in water, as would portions of algal fronds; and which, when examined under fairly high powers of the microscope, agree absolutely in dimensions and structure with the fibrovascular bundles of the leaf-sheaths of *Posidonia australis*. In this plant the submerged old stems are covered with long loose filaments, which are the stout vascular bundles of the leaf-sheaths, persistent long after the parenchyma has decayed away. These bundles are much stouter than those of the leaves proper, and are the only ones found in the Sea Balls. Even the leaves, however, of *Posidonia* are exceedingly tough and durable, and are found heaped up in banks in places along the sandy shores. Maceration, including boiling, tried for three weeks failed to separate the bundles. The source of the fibre of the Balls was detected by Mr. Betche, who examined similar structures from South Australia. The Port Stephens material is identical with that of these. It is remarkable that in the specimens examined there was no sign of a foreign nucleus, and that they were free from inclusions of sand-grains. When cut through, no grit was felt by the knife. Mr. Halligan sent up a fragment of *Champia*, a glutinous seaweed which grows in moss-like clumps, amongst the fronds of which were entangled some of the fibres. In rough weather these clumps were noticed floating rather abundantly in the waves. Supposing the fibres also, probably in numbers together, to be floating, the *Champia*, and possibly some other algæ, would serve as a nucleus around which the fibres would gather. The rough and tumble of the waves seems to account for the felting, and the soft alga in the midst easily and soon decaying, the felt then becomes continuous. The fibre-masses sink at once in fresh water, but they are light and buoyant enough to be kept rolling an indefinite time in tidal currents. It seems plain that they cannot be formed by rolling on the sandy beaches, for the meshwork is so close that sand-grains once enveloped could not be worked out, even if the ball worked out to sea again. The puzzle in the matter seems to be the liberation of the fibres from the stems, which usually grow at some length, though in Port Stephens there are stretches of mud which come near to the surface at low water, and these are covered with *Posidonia*. Possibly the black swans, which feed on the shoots, may play their part in setting free the fibres. (See a paper on "Water-rolled Weed-Balls," by A. H. MacKay, Proc. Trans. Nova Scotian Inst. Science, xi., p. 667, 1908).

Drs. Petrie and Chapman exhibited a photographic plate which had been exposed in the dark to the emanation of the dried juice of *Euphorbia peplus*. A definite imprint of the characters written with the juice was produced on the plate. Ether extracts of the juice contained the active substance.

Mr. E. C. Grey exhibited fatty acids obtained from human brain, comprising, besides the fatty acids already known to occur in combination as lipoids of brain, two specimens of fatty acids, the presence of which has not been previously made known. The fatty acids were separated into a liquid and a solid portion; the former has been shown to contain linoleic acid as well as oleic acid. The solid portion was separated into fractions, which were exhibited, one of them consisting of a fatty acid of high molecular weight, not previously found in the brain.

Mr. Cheel exhibited an interesting series of Fungi, including TRICHIACEÆ: *Lycogala epidendrum* Rost.; on bark; National Park (F. Hallman; November, 1908)—PUCCINIACEÆ: *Puccinia haemodori* P. Henn; host, leaves of *Conostylis aurea* Link; Perth, W.A.(H. Deane; November, 1908). *P. Morrisoni* McAlp.; host, *Pelargonium australe* Willd.; Cowcowing, W.A. (Max Koch; September, 1904). *P. lagenophoræ* Cke., æcidia-stage only; host, leaves of *Lagenophora Billardieri* Cass.; Mount Victoria (E. Cheel; December, 1900). *P. dampieræ* Syd.; host, *Dampiera leptoclada* Benth., and *D. spicigera* Benth.; Albany and Murchison, W.A.(ex herb. E. Pritzel).—THELEPHORACEÆ: *Thelephora terrestris* Ehrh.; on the ground, among leaves; Penshurst (E. Cheel; August, 1907).—DEMATIACEÆ: *Cercospora viticola* (Ces.) Sacc.; host, vine-leaves (*Vitis vinifera* Linn.); Penshurst and Schofield's (E. Cheel; August and December, 1908).

Mr. A. F. Basset Hull submitted a copy of "A List of the Birds of Australia," &c., comprising 904 species, recently compiled and published for the use of collectors and others.

NOTES ON SOME PARASITIC PROTOZOA.

By T. Harvey Johnston, M.A., B.Sc., Assistant Microbiologist, and J. Burton Cleland, M.D., Ch.M., Principal Assistant Government Microbiologist.

(From the Bureau of Microbiology, Sydney, New South Wales.)

(Plate xlviii.)

The recently created Bureau of Microbiology is now undertaking a systematic search of the Australian fauna, both domesticated and native, with a view to finding out what parasites occur here. So far, probably two hundred specimens have been examined for hæmatozoa, and about the same number for intestinal parasites. Some of the results have already been made known in other publications. It is hardly necessary to point out that in the majority of cases parasites, especially those which infest the blood, were absent. Some of those which we have seen are now discussed in this paper.

Leucocytozoon (Hæmogregarina) muris Balfour.

(Plate xlviii., figs. 1-11.)

In 1906, one of us(J.B.C.)(1) while examining the blood of various rats in Perth, West Australia, noticed that the mononuclear leucocytes of *Mus alexandrinus* Geoff., were parasitised by an organism similar to that described by Balfour(2) from *Mus decumanus* Pallas, from the Sudan as *Leucocytozoon muris*. These organisms from Perth were recorded by mistake as *L. balfouri* and *L. ratti* from *Mus decumanus*. The rats were subsequently identified by Oldfield Thomas, on specimens being forwarded to the British Museum, as being *Mus alexandrinus* Geoff.

Quite recently the other of us(T.H.J.)(3) found the same parasite in two rats (*Mus decumanus*) caught in Sydney, and brought into the Bureau (along with many others) for examination. The organism in question is probably rare, since, although over a hundred blood-films from rats and mice have been examined here, on no other occasion has it been detected, though *Trypanosoma lewisi* Kent, is not uncommonly met with here in *M. decumanus*, *M. rattus* and *M. alexandrinus*.

As was mentioned by Balfour, the parasite infests the extra-nuclear part of the mononuclear leucocytes. He found it in the blood from the heart, liver, and spleen, but not from the kidney and bone-marrow. This agrees exactly with what we have seen, though smears from the spleen showed very few forms. Encapsuled hæmogregarines (figs. 10-11) were present in the plasma from the heart and liver, having been set free by the mechanical destruction of the parasitised cell in making the smears. Unencapsuled free forms were not seen, nor were any segmenting stages (schizogony) detected in sections of the liver, kidney and spleen in both West Australian and Sydney specimens. Only a few young parasites were seen (fig. 8). They did not possess a capsule. The shape was mostly slightly crescentic; both extremities were blunt, one usually being somewhat wider. The nucleus was situated either centrally or a little nearer one end.

The commonest type was a more or less oblong encapsuled form representing an adult sporont. The size was from 6-10μ long by 2-5 wide. There is thus a greater variation in size than that noted by Balfour, who stated the measurements to be between 9 and 10·5μ long by 4·5 broad. As a rule the parasites were not crescentic, though such forms were not rare (fig. 10). The usual shape was that of a fairly solid body, the middle of which was as wide or only slightly wider than each end, the ends being of the same size and very bluntly rounded off (figs. 4-7). In one instance the organism closely resembled in form certain hæmogregarines from the erythrocytes in snakes, there being a somewhat wider anterior end gradually tapering into a narrow posterior end which was bent round to form a "tail" (fig. 3), the whole animal being surrounded by a wide capsule. Another fact worth noting in reference to this specimen, which was seen in a smear from the liver, is that the host-nucleus was divided into two quite separated portions.

The nucleus of the adult parasite was seen as a large conspicuous mass (Giemsa's stain), generally centrally situated, though in a few instances it was placed very obliquely. The capsule was usually quite distinct, there being in most specimens a considerable space between it and the enclosed parasite.

Commonly the organism occupied nearly all the extranuclear part of the leucocyte. Its position in the host varied considerably, though the most usual position was parallel to the inner side of the somewhat bean-shaped host-nucleus (fig. 6). At other times the parasite was obliquely, and in a few cases transversely, placed (fig.2). The host-nucleus was occasionally indented, especially by the transversely situated forms (fig.4), and in a few cases was actually divided (fig.3).

Schaudinn has stated that a leucocytozoon is a stage in the life cycle of a spirochaete or a trypanosome. If this be correct, which seems to us to be improbable, may *L. muris* and *Trypanosoma lewisi* be different phases of one organism?

In the films from one of the infected rats, both *L. muris* and *T. lewisi* were present, whilst in the other there were no trypanosomes.

HALTERIDIUM NETTIONIS, sp.nov.—A blood-parasite of *Nettion* (*Anas*) *castaneum* Eyton.

(Plate xlviii., figs.15-17.)

An examination of blood-films from an Australian teal, *Nettion castaneum* Eyton, New South Wales, prepared by the Director of the Bureau in 1907, and handed to us for examination, revealed the presence of Halteridia. These differ from the other Halteridia (*H. chrysops*, *H. meliornis*, *H. geocichlæ*, *H. philemonis*), which we have described(4) from Australian birds, in the large size of the parasite as regards the host-cell, and by the number and large size of the melanin-granules. The parasites were not numerous, but two types could be distinguished, extremes of which almost certainly represent the sexes, the intermediate types perhaps the schizonts.

(*a*) *Male gametocytes* (fig.15).—Protoplasm shows very pale staining or none at all. In one there were thirteen masses of melanin, larger than in the female type, and, though fairly evenly distributed, grouped more towards the poles of the host-nucleus. The host-nucleus was distinctly displaced. In another, the melanin granules were similarly large, fairly evenly distributed, though tending to form three groups, one towards each end and one in the middle, the nucleus not as yet displaced.

(*b*) *Female gametocytes*(fig.16).—Protoplasm decidedly stained. In two specimens, the pigment appeared as twenty-four to thirty masses, smaller than in the male form but larger than we have seen in other Australian Halteridia, more or less uniformly distributed, though in one with a tendency to be more numerous towards the end of the parasite. The host-nuclei in these were pushed to an almost lateral position, and the parasites occupied the whole of the host's protoplasm save a narrow band on the distal side of its nucleus. In another example, the pigment was more aggregated into three groups towards the two ends and in the middle of the parasite, the parasite was not quite so large, and the host-nucleus less displaced.

(*c*) The only intermediate form seen (fig.17), perhaps a three-quarter grown schizont, had the protoplasm staining intermediately between the other two forms, with smaller granules at each end and a few in the middle.

The size of the corpuscles of this bird were 12·5 by 7μ, the nuclei of the corpuscles 5 by 3μ, and the parasite 18 (measuring along the middle and around the bends) by 4μ.

Blood-films from two birds were examined, the parasites occurring only in one.

We propose for this parasite the name *Halteridium nettionis*, the specific name being derived from the generic name of the host.

The type-slide has been presented to the Australian Museum, and the co-types are being retained by the Bureau.

Plasmodium passeris, n.sp., from the Sparrow, *Passer domesticus*.

(Plate xlviii., figs.19-24.)

In March, 1909, a sparrow fell dead from its roosting-place one evening, and was picked up and submitted for examination by Mr. R. Grant, of the staff of the Bureau. Blood-films showed the presence of Plasmodia. In the early stage, these appeared as small amœboid masses, of slightly irregular outline, faintly stained bluish with Giemsa, and situated at or quite near one end of the host-cell. In double infections of one cell, the two parasites were found together at one end, one lying usually a little more laterally to the other, or at opposite ends of the host-cell.

As they increased in size, small melanin-granules became discernible, and the nucleus of the red corpuscle was gradually displaced to one side to make room for large, more or less spherical, bodies. Eventually, in the older forms, the host-nucleus had been extruded, the rounded parasite occupying its place in the distorted red cell. Finally, some examples of this stage of the parasite were found free in the plasma. In these large forms, one or two vacuoles were occasionally to be seen, and melanin in varying amounts was present in all. This pigment seemed to occupy no particular position, being scattered irregularly as small granules or aggregated in larger masses in various situations.

Two types could be distinguished in the large parasites: a very pale form and a well-stained, somewhat granular form. Apparently these represent, the former male gametocytes, the latter female. No definite difference in the amount or disposition of the pigment could be detected between the two forms. No parasites were seen in any stages suggestive of schizony.

The following is a description of ten consecutive full-sized parasites, arranged according to the types presented :—

(1) Very pale. Host's nucleus has disappeared. A few small scattered grains of melanin.

(2) Very pale. Host's nucleus displaced. Pigment as four or five small masses.

(3) Fairly well-stained protoplasm. No host-nucleus. Pigment as two masses and three granules.

(4) Fairly well-stained protoplasm. Parasite free. Melanin as a number of small masses.

(5) Well-stained protoplasm. Host-nucleus displaced. Melanin as four or five small granules.

(6) Well-stained protoplasm. No host-nucleus. Melanin as a group of granules.

(7) Well-stained protoplasm. Host-nucleus displaced. Melanin as five or six small masses.

(8) Well-stained protoplasm. Host-nucleus displaced. Melanin as a large mass to one side.

(9) Well-stained protoplasm. Host-nucleus displaced. Melanin as two irregular masses.

(10) Well-stained protoplasm. Host-nucleus as a mass and smaller granules.

One of us (T.H.J.) (8) has previously recorded this parasite as *Plasmodium præcox*(?), but a fuller examination has emphasised in our minds the differences then noted between this parasite and the descriptions of the true *P. præcox* available to us. For instance, Minchin(9) points out the bean-shaped character of the gametocytes of *P. præcox*; those of our parasite are practically spherical. That our bodies were for the most part full-grown is evidenced, we think, by red cells being frequently found in which the nucleus had been turned out, and the parasite occupying nearly the whole of the corpuscle. Again, it can hardly be that all the large spherical forms represented schizonts, all exactly at the same stage and ready to form merozoites, but none showing evidence of doing so.

A reference to the description of *Plasmodium majoris* Laveran, in Lühe's(7) article in Mense's "Handbuch der Tropenkrankheiten," shows that the gametocytes of our organisms are only about half the size of the gametocytes of that parasite (5 to 6·5μ as against 11 to 12μ). In the same work, *P. Vaughani* (Novy and McNeal) is stated, from its small size, not to displace the nucleus materially, which our parasite does.

We are, therefore, unable to place our parasite under any of the known forms, which seems to us remarkable in that the common sparrow is not a native of Australia, and we should expect that all its hæmatozoa were known. It may be, of course, that this parasite is not one imported with the sparrow, but acquired from some other source, such as some Australian bird, in which it has not yet been detected. On the other hand, since the sparrow was introduced into Australia many years ago, the descendants of the original pairs must now have reached the 60th or 70th generation; and the descendants of the parasites, if these were imported with the originals, an enormously greater number of generations. It is, therefore, possible, though perhaps improbable, that our parasite represents a variety of *P. præcox*, which has evolved during this period.

Though, as we have elsewhere stated, we are adverse to species-mongering, we think advantage follows the labelling, by specific names, of parasites differing in detail from the description of the type-species: by doing so, attention is called to them, and, when monographing the groups takes place, they can, as future work decides, maintain their rank as true species, or sink their identity under a synonym. We, therefore, propose, tentatively, the name *Plasmodium passeris* for this species.

We have examined a dozen sparrows, finding the hæmatozoon in two. The intestine of one of the birds was infested with a tapeworm, *Monopylidium passerinum*, not previously known from Australia.

The type-slide has been presented to the Australian Museum, and cotypes are being retained by the Bureau.

Spirochaetes in the cæca of *Mus decumanus* and *M. rattus*.

In the rats, *Mus decumanus* Pall., and *Mus rattus* Linn., captured in Sydney, films made from the cæcal contents and stained by Giemsa's method, frequently show numerous very small spirochaetes, uniformly dispersed through the smear or collected more or less in groups. These are necessarily often almost hidden by the number of bacteria present. The spirochaetes are very small and delicate, with 2 or 3 spirals, sometimes regular, at other times very irregular in their windings, with apparently blunt ends, and usually about 2·5μ long, though occasionally somewhat longer.

Dr. Max Lühe,(7) in Mense's "Handbuch der Tropenkrankheiten," (iii. 1906, p.184), mentions that spirochaetes have been observed in the stomachs of various animals, such as dogs, cats, and "Wanderratte" (*Mus decumanus*). The number of windings is usually 9 to 11, but may be between 2 and 24. This wide variation suggests that the spirochaetes we have met with in the cæcal contents are of a different species whose size is more constant. As they have so far been met with more frequently in *Mus rattus*, we propose the provisional name of *Spirochaeta ratti* for them, for convenience in future reference.

The presence of these spirochaetes in rats is of special interest, in view of the discovery some while ago of spirochaetes in malignant tumours of rodents. Quite recently, these bodies have been found to be in no way etiologically related to the tumours, but accidental associations.

Rounded Bodies, possibly Protozoal, in the Blood-Corpuscles of a Leather-jacket Fish (*Monacanthus* sp.).

(Pl. xlviii., figs.12-13.)

In smear-preparations of the blood of a fish known as a Leather-jacket (*Monacanthus* sp.) obtained at Broughton Island off Port Stephens, N.S.W., by the Director in 1907, and handed to us for examination, many of the corpuscles contained rounded, usually quite circular bodies of various sizes from 0·8μ to 1·5μ in diameter, situated close to but quite separated from the nucleus of the cell. There was a marked contrast in the staining reactions by Giemsa's method between these bodies, the nucleus of the host, and the protoplasm of the host. The latter assumed a greenish-blue tint, the nucleus a deep blue, and the bodies a pale pink with a less stained centre. Many of the cells contained these bodies; perhaps 1 in 10 did so. In no instance were two found in one red cell.

The corpuscles of this fish (which varied slightly in shape from oval to almost spherical, according, presumably, to the position in which they were fixed) were 8 to 9μ long by 5·5 to 7·5μ broad. In another similar fish caught three days before, and in which the blood-slides were apparently tinted exactly in a similar way, these bodies do not appear.

The nature of these bodies seems uncertain. The fact that, though a considerable percentage of the red cells contained them, in no instance were two found in one cell is rather against their being protozoa. This is important when we consider the comparative frequency of double infections of cells in the Halteridia of birds, and the Plasmodia of birds and man. On the other hand, as these bodies in no way suggest the product of degenerative processes, we are forced to consider them, if not protozoal, as more or less normal products of the cell either when in its younger condition or adult form. This at once suggests that they may represent the centrosomes of the corpuscles which have been recently described by Ronald Ross, Moore, and Walker,(6) in the red corpuscles of the axolotl, the crocodile, man, etc.(Trans. Path. Soc. Lond. Vol.lviii. 1907, p.107). These were described by them as follows in the case of the axolotl :—

"Outside the nuclei, however, one or more small bodies appeared. These were very sharply defined and stained bright red. Very often there were but two, one larger than the other, and frequently they were kidney- or bean-shaped; often, however, there were more than two, sometimes as many as seven or eight, or even more. They were almost invariably close together in one group, frequently connected by filaments, and generally near the nucleus." These bodies, however, are quite unlike the undoubted centrosomes, to be presently described, that we have met with in the red cells of two specimens of Australian tortoises, being larger, more spherical, and less deeply stained.

Sarcosporidia in Pigs, Sheep, Cattle and Rodents.

The following Sarcosporidia have been met with by us. Some of these, we believe, are recorded for the first time in Australia. *Sarcocystis meischeriana* Kühn, in the musculature of pigs in West Australia; *Sarcocystis* (*Balbiania*) *gigantea* Raill., in the œsophagus of sheep in New South Wales and West Australia (in the latter case probably imported from Victoria); *Sarcocystis tenella* Raill., from the muscles of cattle in New South Wales; and *Sarcocystis muris* Blanch., in *Mus rattus* and *M. decumanus* in Sydney.

Trypanosoma lewisi Kent.

As in other parts of the world, *T. lewisi* is not uncommon in *Mus rattus* and *M. decumanus* in Sydney. Its presence has already been recorded in Australia by Pound from Brisbane, and ourselves from Perth, West Australia, and from Sydney.

Centrosomes in the Erythrocytes of Tortoises.

(Plate xlviii., figs.14, 18.)

In the red blood-corpuscles of certain tortoises, *Chelodina longicollis* from Sydney, and *C. oblonga*(?) Gray, from near Perth, West Australia, we have seen bodies resembling the centrosomes described by Ross, Moore and Walker. In the case of the former, the structure consisted of irregularly disposed threads surrounded by a rather lighter staining area (fig.14), whilst in the latter there were four or five well defined masses arranged somewhat like a rosette (fig.18).

Basophile Granulations (Plehn's Bodies) in the Red Corpuscles of Cows suffering from Endemic Hæmaturia of Vesical Origin.

In certain parts near the coast-line of New South Wales, cases of endemic hæmaturia, due to weeping from vascular papillomata of the bladder, are often met with in cattle.(5) No parasitic worms have been found causative of these papillomata, and no hæmatozoa have been found in the blood. The disease is popularly, and perhaps rightly, considered to be due to the slow action of some vegetable poison.

The loss of blood from these little tumours seems considerable, and a secondary anæmia is the natural consequence. On examining blood-slides from two comparatively early cases in which we were enabled to hold post mortems, the number of red cells with basophile granulations was striking. In the first case, a percentage of about ten were found to contain these, but they were less numerous in the second case. The granules appeared as minute dots, thirty or more in number, uniformly peppering the corpuscle, as fewer but larger very short rods, or as still fewer (about 8 to 10) irregular bodies. The cells containing the many minute dots were usually polychromatophilic, while those with larger bodies were normal in tint. Occasionally unaffected red cells were similarly polychromatophilic.

In addition to these basophile granulations, red cells with nuclei whole or partly disintegrated and absorbed, could be found without difficulty. In all these the nuclei or their remains were stained a deepish purple. The cells with large whole nuclei were usually polychromatophilic. All stages were seen between such nuclei, occupying about two-thirds of the corpuscle, and small often somewhat eccentric deep round purple bodies. Further, other instances were seen in which a large nucleus was irregularly broken up into several irregular masses still in connection with each other, and these were likewise of various sizes.

The basophilic bodies are probably the "chromo-linin granulations," described by C. E. Walker,(6) in the red corpuscles of mammals (Trans. Path. Soc. Lond. lviii. 1907, p.99), evenly distributed throughout the corpuscle. As he points out, these are almost certainly the remains of nuclear matter, and cells containing them can be met with in normal bone-marrow, though they do not appear in the blood under ordinary conditions. When, however, there is a drain upon the blood-system, as in anæmias of various origin, these cells as well as nucleated red cells, with nuclei complete or partially disintegrated, may, in the hurry to remedy the defect, enter the circulating blood. This would account for the number of the cells with basophile granules in this case, as well as for the increase of nucleated red cells. Further, there is indicated a close relation between the granular cells and the still nucleated ones, the latter being of a still earlier type than the former.

The Director has shown us a photograph of cells with exactly similar basophile granules from Piroplasmosis (Tick Fever) of Cattle, obtained by him several years ago. Here the same conditions causative of their appearance, that is profound anæmia, would be present. Similar cells are occasionally found in man. Dr. Tidswell at the same time reminded us of Türck's view that the granules in question were not nuclear, but arose from the cytoplasm.

LITERATURE.

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3. Johnston—Agric. Gazette, N.S. Wales, xx., 1909, p.581; Proc. Linn. Soc. N. S. Wales, 1909, xxxiv., p.218.
4. Cleland and Johnston—Journ. Proc. Roy. Soc. N. S. Wales, xliii., 1909, p.75.
5. Cleland—Proc. Linn. Soc. N. S. Wales, 1909, xxxiv., p.216.
6. Ross, Moore, and Walker—Trans. Path. Soc. Lond. lviii., 1907, p.99.
7. Luehe, in Mense's "Handbuch der Tropenkrankheiten," iii., 1906, p.184, etc.
8. Johnston—Rec. Austr. Mus. vii., 1909, p.344.
9. Minchin, in Ray Lancaster's Treatise on Zoology, Pt.1, fasc. ii., 1903, p.268.

EXPLANATION OF PLATE XLVIII.

Figs.1-11.—Mononuclear leucocytes of *Mus decumanus* containing *Leucocytozoon muris* Balfour.

Figs.1,4-10.—Ditto, from heart-blood.

Figs.2,3,11.—Ditto from liver-smear.

Figs.1,5,6,7,9.—Encapsuled forms.

Figs.2,4.—Host-nucleus partly divided by parasite.

Fig. 3.—Host-nucleus quite divided by parasite.
Fig. 10.—Encapsuled form free in plasma (blood from heart).
Fig. 11.—Encapsuled form free in plasma (blood from liver).
Figs. 12, 13.—Erythrocytes of *Monacanthus* sp., showing "ring" bodies.
Fig. 14.—Erythrocytes of *Chelodina longicollis* with centrosome.
Figs. 15-17.—*Halteridium nettionis* in erythrocytes of *Nettion castaneum*.
Fig. 15.—Male form.
Fig. 16.—Female form.
Fig. 17.—Young intermediate form.
Fig. 18.—Erythrocyte of *Chelodina oblonga* showing centrosome.
Figs. 19-24.—*Plasmodium passeris* in erythrocytes of *Passer domesticus*.
Fig. 19.—Young amoeboid non-pigmented parasite.
Fig. 20.—Double infection by young forms.
Figs. 21, 22.—Adult form, host-nucleus displaced.
Fig. 23.—Adult form, host-nucleus expelled.
Fig. 24.—Young pigmented form.
Fig. 25.—*Spirochaeta ratti* from cæcum of *Mus rattus*.

References to lettering:—*n.*, host-nucleus—*p.*, parasite—*c.*, capsule of parasite.

All figures have been drawn, using the same magnification.

THE ENTOZOA OF MONOTREMATA AND AUSTRALIAN MARSUPIALIA. No. i.

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(From the Bureau of Microbiology, Sydney, N.S.W.)

Some little time ago, there was placed at my disposal a collection of Australian Entozoa, a goodly number of which were from marsupials. The greater part of the collection was got together by Prof. J. P. Hill, D.Sc., while in Australia, and Mr. S. J. Johnston, B.A., B.Sc., of the Biology Department, Sydney University.

I have thought it advisable that the first paper under the above heading should be of an introductory character. Since no one as yet has brought together a systematically arranged list of the known or imperfectly known parasites of these two interesting Orders of mammalia, it is my intention to state under each host the names of its known Entozoa, with a list of references to each. Dr. G. Sweet(36) has recently published a Census of Australian Entozoa, in which many of the following references have been noted. Dr. von Linstow(29) mentioned some of the earlier records in his "Compendium der Helminthologie," 1878, and its Supplement, 1888.

The most important workers in this subject are Prof. Zschokke and Dr. Janicki (Cestoda), and Dr. von Linstow (Nematoda). A fair number of imperfectly described forms have been recorded, amongst them being Krefft's species,(24) all of which require redescription in order to place them systematically.

Although the work will be almost entirely restricted to Cestoda, yet for reasons mentioned I have preferred to use the wider term

"Entozoa." The numbers in thick type refer to literature indicated in the bibliography, in which the forms are mentioned.

MONOTREMATA.

1. ORNITHORYNCHUS ANATINUS Shaw (syn. *O. paradoxus* Blumenb.).

Distomum ornithorhynchi S. J. Jnstn.(**21**) (N.S.W.). This is the only endoparasite described from the Platypus. Dr. Cobb mentioned that he found one, but did not indicate to what class it belonged.

2. TACHYGLOSSUS ACULEATUS Shaw (*Echidna hystrix* Home).

Linstowia echidnæ Thompson(**37**)(N.S.W., Queensland).
Tænia phoptica Cobbold(**12**)(Queensland ?).

Linstowia echidnæ was originally described as *Tænia echidnæ* by Thompson,(**37**) from material taken from New South Wales to London by Prof. Anderson Stuart. Prof. Zschokke(**45**), however, gave a much fuller account, based on specimens collected by Dr. Semon in Queensland, making it the type of a new genus, *Linstowia.*

Cobbold(**12**) in his book "Parasites: a Treatise on the Entozoa, etc.," mentioned that he had examined some cestodes collected by Dr. Bancroft of Queensland, from the common Australian Echidna, *Tachyglossus setosus* (which is only a variety of *T. aculeatus*). The strobilæ of these averaged three inches in length, the segments being very narrow, and closely set. By the term narrow, he apparently referred to their length, as he stated that the greatest width was three-eighths of an inch. He gave the name *Tænia phoptica.* The above-mentioned characters agree fairly closely with those of *L. echidnæ,* and there is little doubt but that the two names refer to the same species, which is a common and rather abundant parasite of the Echidna. Cobbold's description is so meagre that I think that the worm should still be known as *Linstowia echidnæ* instead of *Linstowia phoptica.* Cobbold's name is little more than a *nomen nudum.*

References to *L. echidnæ,* **12,20,34,37,40,41,42,43,44,45.**

MARSUPIALIA.

3. Macropus giganteus Zimm. (syn. *M. major* Shaw).

Moniezia festiva (Rud.)(8,12,14,15,24,33,40,43,44,45).
Echinococcus polymorphus Dies.(22,31).
Distomum (Fasciola) hepaticum Abildg.(4,12,14,22,24,33).
Filaria websteri Cobbold(12,14,17).
Filaria sp., Bancroft(1).

Moniezia festiva infests the gall-bladder and bile-duct. It was originally described very briefly by Rudolphi(33) as *Tænia festiva*, and figured by Bremser.(8) The locality mentioned was "Australia." Dujardin(25) and Diesing(14) merely repeated Rudolphi's short account. No other helminthologist, except Cobbold(12), appears to have studied this worm, though Blanchard(5) recognised that, from Rudolphi's description, the species would probably come under his new genus *Moniezia*. Krefft(24), Stiles(25), Zschokke(45,46,47) and Janicki(20) referred to this parasite, but did not add any new facts. I have recently examined superficially some specimens collected in New South Wales from this host, which apparently belong to *M. festiva*.

Pagenstecher(31) recorded the occurrence of hydatids (*Echinococcus polymorphus* Dies.) in a Great Kangaroo which had died in Cologne.

The common liver-fluke *Distomum (Fasciola) hepaticum* Abildg., is not infrequently met with in the bile-ducts of various kangaroos, including this species. Rudolphi(33), Diesing(14), Bremser (quoted by Diesing), Cobbold(12), Bennett(4), Braun(7) (from Australia), Krefft(24) (from New South Wales or Queensland), and myself(22) (from New South Wales) have recorded its presence.

Filaria websteri Cobbold (syn. *F. macropodis gigantei* Webster), has been mentioned by Webster, Cobbold(12), and Fletcher(17) as infesting the knee-joint of this host. *Filaria* sp., recorded by Bancroft(1) is probably the same species.

It is quite possible that the hydatid and the liver-fluke have established themselves as parasites of the Marsupialia, since the settlement of the white man, with his domesticated animals in this continent. Fielder has shown that the eggs of the fluke may pass through the typical larval stages within some of our fresh-water gastropods, especially species of *Bulinus* (*Limnaea*). The cercariæ produced might, after encystment on grass, etc., be transferred passively with the food into herbivorous marsupials, and reach maturity, in the same way as in sheep and cattle, in both of which fluke is not uncommon in Eastern Australia, especially in New South Wales and Victoria.

Tænia echinococcus v. Lieb., the adult of the hydatid, occurs in dogs in New South Wales, Tasmania, South Australia, West Australia, and most probably in the other States, and has been recorded by von Lendenfeld, Cleland (West Australia), Braun (Australia), and Stirling (S. Australia) from *Canis dingo*. We do not know whether the dingo harboured this parasite before the arrival of the dog, and it is therefore not yet possible to state definitely whether the hydatid has established itself comparatively recently in the Marsupialia. The examination of hosts from parts of the continent where the dog is unknown, would assist in deciding both questions. It may not be out of place to mention that the hydatid is, in all probability, the commonest endoparasite in Australia, being frequently met with in New South Wales in human beings, sheep, cattle and pigs, and rarely in horses. The same remark applies equally to other parts of the Commonwealth.

4. Macropus dorsalis Gray.

Echinococcus polymorphus Dies.(2,11,22) seems to be the only recorded parasite. Dr. Bancroft(2) of Queensland, recorded its presence in the lungs, Cobb(11) merely mentioning this reference.

5. Macropus derbyanus Gray.

Moniezia festiva Rud., has been identified by Cobbold(12) from this host (Dr. Bancroft's collection, Queensland ?).

6. Macropus antilopinus Gould.

Filaria roemeri v. Linstow(29)(Australia).

7. Macropus browni Ramsay.

Cloacina dahli v. Linstow(28); a nematode from the alimentary canal (Bismarck Archipelago).

8. Macropus ualabatus Less. & Garn.

Zoniolaimus setifera Cobb(9); a nematode inhabiting the stomach of the brush wallaby (New South Wales). Cobb(9) also mentioned *Z. brevicaudatus* Cobb, but did not state the name of the host. Perhaps it was also obtained from a macropod.

9. Macropus ruficollis var. bennettii Waterh.

Filaria sp.—Eisig(18) mentioned the occurrence of a Filaria in the pericardium of *Macropus bennettii* Waterh., but no locality was stated. This host is now regarded as a variety of *M. ruficollis* Desm.; and, since it only occurs in Tasmania, we may safely set down that island as the locality of the specimen.

10. Macropus sp.

I am including under this heading the names of entozoa recorded from hosts designated "kangaroo," "wallaby," *Macropus* sp., and *Halmaturus* sp.

Cittotænia zschokkei Janicki(20,19)(*Macropus*; New Guinea).
Bothriocephalus (?) *marginatus* Krefft(24)(wallaby; Queensland).
Tænia fimbriata Krefft(24)(northern wallaby?).
Tænia mastersii Krefft(24)(*Halmaturus*; Queensland).
Distomum hepaticum Linn.(wallaby, kangaroo; loc.?).
Filaria spelæa Leidy(25)(wallaby; Australia).
Filaria websteri Cobbold(12)(kangaroo; Queensland ?).
Filaria sp. Crisp(13)(kangaroo; loc. ?).

The hosts of two of Krefft's species(24), viz., *Bothriocephalus*(?) *marginatus* and *Tænia fimbriata* are not known for certainty, though both probably came from Queensland wallabies. The specific name *fimbriata* was already preoccupied in the genus *Tænia* by Diesing (*T. fimbriata* Dies., = *Thysanosoma fimbriata* Dies.), and consequently cannot stand for Krefft's species. Since the latter possesses bilateral genital pores, whilst Diesing's has unilateral, they are at least specifically distinct; and accordingly I would suggest the name *Tænia*(?) *kreffti* for this headless specimen.

Tænia mastersii Krefft(24), is not a true Tænia. It probably belongs to the *Anoplocephalinæ*.

Cobb(10) mentioned having found the liver-fluke in wallabies and kangaroos (New South Wales?). Braun(7) also recorded its occurrence.

Filaria spelæa Leidy(25), was taken from the abdominal cavity of an Australian wallaby, and may be identical with one which I have seen from a similar situation in *Macropus ualabatus* (N. S. Wales).

Bancroft(3) recorded the occurrence of *Filaria websteri* in a kangaroo; whilst Crisp(13) mentioned *Filaria* sp., from the knee-joint of the same animal, apparently referring to *F. websteri*.

11. Petrogale penicillata Gray.

Triplotænia mirabilis Boas (6) [6,18,20,44].

Filaria australis v. Linstow(27),(Australia).

The former is perhaps the most remarkable adult cestode known, since it consists of an extremely short median strobila, while from each side of the hind part of the scolex there arises a long lateral strobila. Hence the appropriateness of the generic and specific names. Janicki(18,20) and Zschokke(44) refer to this parasite of the above-named rock-wallaby, the former regarding it as a monstrosity arising by the division of an original strobila, Galli-Valerio (in Centr. Bact. f. Parasit. Orig. i. xxxix. 1905, p. 239), supporting this view. *Filaria australis* was found in the body-cavity.

12. Phascolomys sp.

Tænia bipapillosa Leidy(25).—This parasite was taken from a wombat in the Philadelphia(?) Zoological Gardens. The description is very imperfect, giving only a few external characters, which agree very closely with Rudolphi's short account, and Bremser's figures of *Moniezia festiva*. The scolices, strobilæ, and arrangement of the genital pores are similar. *Tænia bipapillosa* possesses external features sufficient to justify its inclusion along with *Tænia festiva* in the genus *Moniezia*. There are in my possession a number of tapeworms agreeing externally with *Moniezia bipapillosa*, taken from a wombat (*Phascolomys mitchelli* Owen) in this State; and I hope that, before long, I shall be able to make known the structure of these two species of *Moniezia*.

13. PHALANGER URSINUS Temm

Bertia edulis Zschokke(42)[42,43,44].

Bertia sarasinorum Zschokke(42)[42,43,44].

These cestodes were collected in the Celebes.

14. PHALANGISTA sp. (= *Trichosurus* sp., or *Phalanger* sp.).

Bertia rigida Janicki(20)[19,20] from an opossum in New Guinea.

14. TRICHOSURUS VULPECULA Kerr (syn. *Phalangista vulpina* Meyer.).

Tænia phalangistæ Krefft(24).

Filaria dentifera v. Linstow(30).

The former was very imperfectly described from a Queensland or New South Wales host. The latter was collected in Queensland by Prof. Semon.

15. PHASCOLARCTUS CINEREUS Goldf.

Bertia obesa Zschokke(45)[42,43,44,45].—Described from material collected in Queensland by Semon. This parasite occurs fairly commonly in the "Native Bear" in New South Wales. Cobbold(12) merely mentioned the occurrence in this host of a tapeworm which he called *Tænia geophiloides*, on account of its general resemblance to a long millipede. The name is valueless as no description was given, and in all probability Cobbold's specimen belonged to the above species, so well described by Prof. Zschokke. By a considerable stretch of imagination, *Bertia obesa* might be likened to a much bleached millipede of the genus *Julus*, on account of its plump rounded form.

16. Perameles obesula Shaw.

Linstowia semoni Zschokke(45)[20,41,42,43,44,45].
Hoplocephalus cinctus v. Linstow(30).
Gigantorhynchus semoni v. Linstow(30).

All the above-named parasites were collected from "bandicoots" in Queensland, by Semon. The last-mentioned parasite is, as far as I know, the only Echinorhynch described from an Australian marsupial.

I have specimens of *L. semoni* and *G. semoni* obtained from this host near Sydney.

17. Perameles nasuta Geoff.

Ascaris sp.—The name is merely mentioned by Krefft(24). There is, in my possession, a cestode resembling *Linstowia semoni*, obtained from this host in New South Wales.

18. Thylacinus cynocephalus Harris.

Dithyridium (Piestocystis) cynocephali Ransom(32). This larval cestode was found in the heart-muscles of a specimen which had died in the Zoological Gardens, Washington, U.S.A.

19. Dasyurus viverrinus Shaw.

Hæmogregarina dasyuri Welsh, Dalyell, and Burfitt(39,23). This sporozoon was found in the erythrocytes of a "Native Cat" from New South Wales.

I have a larval Bothriocephalid Cestode, *Sparganum* sp., taken from the body-cavity of this host, from Sydney district.

20. Petaurus sciureus Shaw.

Hæmogregarina petauri Welsh and Barling(38,23). A parasite of the erythrocytes of a "Flying Squirrel," from this State.

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REVISION OF THE *AMYCTERIDÆ.*

Part i. Genus *Psalidura.*

By Eustace W. Ferguson, M.B., Ch.M.

The Australian *Curculionidæ* comprising the subfamily *Amycteridæ* constitute a natural and striking group of weevils, peculiar in their structure and habits. The species are for the most part large, and are all wingless, with extremely short rostra, hard elytra, so hard as frequently to bend the pin in trying to pierce them, and antennæ with a six-jointed funicle.

They have been divided somewhat arbitrarily into the long- and short-scaped forms, both groups being found over the whole Continent, but more numerous respectively on the east and west sides.

The long-scaped forms again constitute two natural groups, one comprising the genera *Acantholophus* and *Cubicorrhynchus*; and the other the genera *Psalidura*, *Talaurinus*, and *Sclerorrhinus*. The genus *Amycterus* seems in many respects intermediate between the two groups. The Psalidurae are peculiar in the structure of the sexual organs of the male, these insects possessing large, curved, anal forceps, projecting posteriorly; these are also present in *Talaurinus*, but are hidden and rudimentary in that genus.

All the *Amycteridæ* are ground-dwellers, being found under logs and stones, while one or two may be obtained from the roots of grass-trees. They are essentially dry-country insects, and seem capable of storing up the vegetable material on which they live, in their abdominal cavities for long periods. In regard to their life-history, we are no further advanced than in Sir William Macleay's day, and nothing is known of the larval or pupal forms of these insects.

The genus *Psalidura* is almost entirely restricted to the eastern colonies, only one species, and that an aberrant one,—*P perlata*, from Eucla—being described from west of Victoria, though *P. flavovaria* may possibly be from South Australia. In Queensland, New South Wales, and Victoria the genus is widespread, and rich in species, while Tasmania has one representative.

On the whole, the genus seems to prefer the higher mountain ranges and tablelands; and, though specimens are by no means uncommon on the plains, the species represented there are less numerous and more widely distributed. While many of the species are quite local in their distribution, others are spread over wide areas of the country.

History.—The first insect of the subfamily was described by Kirby in 1818, under the name of *Curculio mirabilis*. Kirby has given two figures of his species, but unfortunately while the figure of the insect seems to indicate a member of the *P. impressa*-group, that of the anal excavation shows it to be a member of the "gular-horn-group"; subsequent describers have all described it as having the gular horn, but Kirby himself does not mention it.

The genus *Psalidura* appears to have been created by Fischer von Waldheim for the reception of *Curculio mirabilis* Kirby. Agassiz' "Nomenclator" gives the following reference: *Psalidura* (Macl.) Fisch v. W., Mém. Soc. imp. Mosc. vi., 1823. On the other hand, Lacordaire and Sir W. Macleay quote W. S. Macleay as the author, (King's Survey, Appendix, 1826). W. S. Macleay has given a very short note on the genus, which he spelt *Phalidura*. Unfortunately I have not been able to sèe Fischer's paper, and cannot ascertain whether he actually described the genus.

The genus *Amycterus* was created in 1826 by Schönherr; his paper also is not available in Sydney; but the name was long used for all species of *Amycteridæ* except *Acantholophus*. Agassiz' "Nomenclator" gives the reference as follows—*Amycterus* (Dalman) Schönh., Disp. Méth. 1826.

If Fischer actually described *Psalidura*, *Amycterus* will have to be regarded as a synonym; for the present, Lacordaire may be followed in ascribing to *Amycterus* those species of which *A. Schönherri* may be taken as the type.

From the time of Fischer and W. S. Macleay, till that of Lacordaire and Sir William Macleay, all the descriptions of species were (with the exception of members of the genus *Acantholophus*) referred to *Amycterus*; these species have since been drafted into various genera, but a few have been placed in Masters' Catalogue under *Psalidura*, and with these I now purpose to deal.

P. granosa Guérin (Voy. de Coquille, ii. (2), 1830).—I have carefully examined the description of this species, which is said to come from Port Jackson, and am of opinion that it should most probably be relegated to *Talaurinus* and possibly as a synonym of *T. bucephalus* Oliv. The following description fits the female of *T. bucephalus* Oliv., or one of its numerous varieties —"le dernier segment de l'abdomen présente au milieu une petite fossette au centre de laquelle il y a unpetit tubercule ovale, lisse et luisant." The dimensions given are—long. 17 mill., lat. 7 mill.

Owing to the kindness of Mr. A. M. Lea, I have been permitted to examine the types of most of Boisduval's species, published in 1835 (Voy. de l'Astrolabe, ii.), seven of which are in Masters' Catalogue as *Psalidurœ*, viz.:—*P. carinata*, *P. crenata*, *P. impressa*, *P. postica*, *P. reticulata*, *P. scabra*, and *P. tuberculata*. *P. carinata* should be referred to *Sclerorrhinus*, *P. scabra* to *Talaurinus*, while *P. tuberculata* is a synonym of *Talaurinus verrucosus* Guér. *P. postica* I cannot recognise, and have not seen the type, but am inclined to think that it is not referable to *Psalidura*.

P. reticulata was described from a female, and will be referred to later on.

P. impressa and *P. crenata* are synonyms, and of the two names I regard *P. impressa* as preferable.

P. mirabunda Gyll., (Schönh., Gen. Curc. ii., p.471, 1834) was unfortunately described from a female, but undoubtedly belongs to *Psalidura*, and probably to the *P. impressa*-group, if indeed it does not prove to be that species.

Bohemann, in 1843 (Schönh., Gen. Curc., vii.(1)) published descriptions of *Amycteridæ*, five of which have been placed in *Psalidura*—*P. d'Urvillei*, *P. Hopei*, *P. mira*, *P. Spencei*, and *P. squalida*. Of these, *P. mira* is a member of the horned-jaw group, and is most probably the species so considered by Macleay; its locality, however, is not Swan River, as recorded by Macleay, but Sydney. *P. d'Urvillei* and *P. squalida*, being founded on female specimens, cannot be recognised with certainty, except by examination of the types. *P. Hopei* should, I think, be referred to *Sclerorrhinus*, on account of the following passages in the description :— "linea frontali laevi, usque ad apicem rostri continuata silaceo-marginata; . . . ; rostrum . . . supra late sed parum profunde bicanaliculatum." *P. Spencei* I cannot recognise, but I do not believe it to be assignable to *Psalidura*.

In the Transactions of the Entomological Society of New South Wales (Vol i., 1865, p 200), Sir William Macleay reviewed the genus, and added twenty new species—*P. abnormis*, *P. caudata*, *P. Coxi*, *P. elongata*, *P. falciformis*, *P. forficulata*, *P. foveata*, *P. Helyi*, *P. Howitti*, *P. Mastersi*, *P. miracula*, *P. mirifica*, *P. Mitchelli*, *P. montana*, *P. rufolineata*, *P. squamigera*, *P. subcostata*, *P. subvittata*, *P. verrucosa*, and *P. Wilcoxi*. Of these names, *P. Helyi* and *P. Howitti* are synonyms of *P. impressa*; *P. mirifica* I have placed as a variety of *P. mira* Boh.; while *P. rufolineata*, though in the present paper maintained as distinct, may come to be regarded as a variety of *P. mirabilis*; in some respects *P. reticulata*, which I have united with *P. mirabilis*, seems intermediate between the two species.

P. decipiens Dohrn, 1872.—I have seen no *Psalidura* small enough to fit the description of this species; tentatively it might be placed near *P. Wilcoxi*.

Since the date mentioned, no new species of *Psalidura* have been described, and although the name *P. mannerheimi* Schön., (Schönh., Mant. Sec. p.55) appears in Masters' Catalogue, it is a manuscript name only. I have had the species now described as *P. Sloanei*, referred to me under the above name.

In 1904, Mr. A. M. Lea* transferred to *Psalidura* the following species referred by Macleay to *Talaurinus* :—*T. penicillatus* Macl., *T. Riverinæ* Macl., *T. exasperatus* Erich., *T. morbillosus* Macl.(nec Boisd.), and *T. tomentosus* Boisd. Although these species have the anal forceps present, but hidden, in the male, yet these latter are rudimentary as they are in all Talaurini; and in other respects, *e.g.*, the length of the intermediate segments of the abdomen are at variance with *Psalidura*, and I have omitted further consideration of these species in the present paper.

Thus in Masters' Catalogue, the names of thirty-seven species of Psalidura appear; of this number I propose to eliminate the names of seven as not belonging to the genus, of five as being synonyms, and of one as a manuscript name only. Of the remaining twenty-four, four are unknown to me, three of them having been described from female specimens. To this number I have added twenty-two new species, making a total of forty-six species. The types of all the new species, with the exception of *P. metasternalis*, are in my own Collection.

In conclusion, I should like to thank the many entomologists who have so kindly helped me in my work, and especially Messrs. Sloane, Lea, Carter, Masters, Rainbow, Illidge, French, and Taylor. To Mr. T. G. Sloane, for his initial incentive to the task in the gift of his own fine collection of *Amycteridæ*, and under whose guidance the work was begun, I shall ever be deeply grateful. To Messrs. Masters and Rainbow I am indebted for the opportunities afforded me of examining Macleay's types in the Macleay and Australian Museum collections. Mr. A. M. Lea, by permitting me to examine the majority of Boisduval's types, has enabled me to make my work far more complete in that direction than I had hoped. To Mr. H. J. Carter my thanks

* Trans. Roy. Soc. S. Austr. xxviii., p.111.

are due for the manner in which he has encouraged me through many difficulties towards the final completion of my task.

PSALIDURA Fischer.

Fischer v. W, Mém. Soc. imp. Mosc. vi., 1823; W. S. Macleay, King's Survey, ii., Appendix, 1826; Lacordaire, Gen. Col. vi. 1863; W. Macleay, Trans. Ent. Soc. N. S. Wales, i., 1865.

♂. Form elongate-ovate, convex. Clothing variable; setigerous. Head convex, separated from rostrum by a transverse sulcus. Rostrum short, thick, external ridges subparallel, internal ridges convergent posteriorly, base bisulcate, median area depressed anteriorly. Scape long, first joint of funicle longer than second. Prothorax granulate; apical lobe varying in degree of production, ocular lobes feeble. Elytra strongly declivous, apex subtruncate, broadly flanged and mucronate; disc striate, interstices granulate or costiform. Undersurface feebly concave. Third and fourth abdominal segments short, together less than second; fifth deeply excavate, abdominal fascicles almost invariably present. Anal forceps fully developed.

♀. Form more elliptical; mandibles always simple; elytra more evenly rounded, apex more gradually produced, not flanged, and not mucronate; undersurface gently convex, intermediate segments larger than in male, fifth segment not excavated.

Fischer's description of the genus I have not seen. W. S. Macleay gives the following note:—" *Obs.* The characters of this most singular genus *Phalidura* are chiefly to be found in the broken clavate antennæ, short thick rostrum, connate elytra, and singular anal forceps of the male." Lacordaire and Sir W. Macleay both give generic descriptions, and I have followed the latter in limiting the genus to those species with the forceps fully developed.

To the above generic description I would add the following notes on the anatomy of the sexual and anal organs of the male; of the parts revealed im dissection (though of generic importance) I have made no use in specific descriptions, beyond the shape of the penis. The anal excavation is a deep semicircular depression, forming in its deepest portion a well defined pit, the preanal fossa; the posterior edge is sinuous, and is produced back between the blades of the forceps. The fascicles vary in size and exact position, but are situated on or near the edge of the excavation. The forceps consist of two blades projecting posteriorly; they are concave on their inner faces, from which spring the blade-like laminæ; these latter and the forceps vary greatly in size. On dissection the inner ends of the forceps are seen to lie in a groove on either side of a projection corresponding to the preanal fossa; to this is attached a median, vertical, chitinous plate, the ends of the forceps being united to this by muscles; also to this plate there is attached a slender curved rod situated asymmetrically on the right side. The penis is hard and chitinous, and varies in the shape of its free extremity. The last two dorsal segments in the male are hard and chitinous; the apical tergite is the longer, is narrowed at the apex, and is overlapped by the broader subapical segment. In the female (as in all *Amycteridæ*) only the last dorsal segment is chitinous.

In the measurements the lengths have been taken from the apex of the rostrum to the apices of the elytra, but, owing to the great convexity of these insects, the total length so taken is often less than the combined lengths of head, prothorax, and elytra. The position in which the head has been set also influences the measurement; while many species present considerable variation in size.

Table of the Species.

Group.

i. 1(12). ♂ with a strong gular horn.

2 (9). Elytral interstices seriate, granulate, none of the interstices costiform.

3 (8). Prothorax closely set with small, round granules.

4 (5). Elytral sculpture irregular, excepting third and fifth interstices, fourth interstice not continued to base. *P. mirabilis* Kirby.

5 (4). Elytral sculpture regular, all interstices reaching base.

6 (7). Size moderate, prothoracic granules finer than in *P. mirabilis*. *P. rufolineata* Macleay.

7 (6). Size large, prothoracic granules not finer than in *P. mirabilis*. *P. Coxi* Macl.

8 (3). Prothorax more sparingly set with larger granules, elytral sculpture rougher and more coarsely granulate.
P. verrucosa Macl.

9 (2). Elytral interstices costiform.

10(11). Second interstice only present in apical half, fourth and sixth interstices wanting. *P. cancellata*, n.sp.

11(10). Second, third, fifth, and seventh interstices fully costate, fourth and sixth granulate. *P. costipennis*, n.sp.

12 (1). ♂ without gular horn.

ii. 13(26). ♂ with external angles of mandibles each produced into a stout horn.

14(25). Interstices costate.

15(18). Abdominal fascicles of ♂ very close together.

16(17). Anal forceps large, the inner faces looking forwards as well as inwards. *P. miracula* Macl.

17(16). Anal forceps smaller, the inner surfaces directly facing.
P. approximata, n.sp.

18(15). Abdominal fascicles separated from one another.

19(20). Pronotum not abraded, granules distinct, fascicles small.
P. mira Boh.

20(19). Pronotum abraded, sublævigate.

21(24). Elytra widely dilated, fully costate, regularly and deeply foveate, colour shining.

22(23). Fascicles large, widely separated. *P. Carteri*, n.sp.

23(22). Fascicles small, much closer together. *P. amplipennis*, n.sp.

24(21). Elytra more shallowly foveate, opaque. *P. sublævigata*, n sp.

25(14). Interstices granulate, prothorax dilated, finely granulate.
P. subcostata Macl.

26(13). Mandibles unarmed in ♂.

iii. 27(30). Each elytron with four interstices on disc (including sutural), interstices costiform.

28(29). Size large, anal forceps meeting at apex. *P. amplicollis*, n.sp.

29(28). Size small, anal forceps not so meeting. *P. sulcipennis*, n.sp.

30(27). Each elytron with seven interstices on disc, interstices for the most part granulate.

31(78). Anal forceps of varying length, but not hidden, and meeting at apex.

32(65). ♂ with inner laminæ of forceps not touching nor overlapping.

33(64). Prothorax more or less produced in a median apical lobe.

iv. 34(41). Metasternum with a deep median emargination when viewed from in front, a protuberance on each side of emargination behind middle coxæ.

35(36). Blades of anal forceps long, stout, tapering from base to apex.
P. elongata Macl.

36(35). Blades of anal forceps short, strongly arcuate, very thick at base.

37(38). Size moderate, sculpture fine and regular. *P. squamigera* Macl.

38(37). Size much smaller.

39(40). Clothing black. *P. montana* Macl.

40(39) Clothing maculate, prothorax trivittate. *P. subvittata* Macl.

41(34). Metasternum without protuberance on each side of middle line behind middle coxæ.

42(59). ♂ with anal forceps long, projecting greatly beyond elytra.

v. 43(56). Laminæ on forceps small, linear, obscured from in front by a fringe of scales.

44(45). Elytral interstices costate, sculpture reticulate. *P. Mastersi* Macl.

45(44). Elytral interstices finely granulate.

46(51). Abdominal fascicles situated well within anal excavation.

47(50). Forceps widely arcuate.

48(49). Elytral sculpture fine, size moderate. *P. forficulata* Macl.

49(48). Elytral sculpture rougher, granules large and strong; size larger. *P. Mitchelli* Macl.

50(47). Forceps stouter, more wedge-shaped. *P. cuneicaudata*. n.sp.

51(46). Abdominal fascicles more or less far apart, situated on edge of excavation.

52(53). Elytral sculpture regularly reticulate. *P. foveata* Macl.

53(52). Elytral sculpture striate, not reticulate.

54(55). Form robust, interstices prominent, setæ yellow. *P. flavosetosa*, n.sp.

55(54). Form not so robust, more finely granulate, setæ dark brown. *P. Frenchi*, n.sp.

vi. 56(43). Laminæ small, not linear, situated at extreme base of forceps.

57(58). Size moderate, penis pointed. *P. caudata* Macl.

58(57). Size for the most part larger, penis obtuse, notched. *P. grandis*, n.sp.

vii. 59(42). ♂ with anal forceps short, not projecting far beyond elytra.

60(63). Elytral interstices all finely and distinctly granulate.

61(62). Bristles on posterior border of anal excavation continued across middle line; supernumerary tufts yellow. *P. Wilcoxi* Macl.

62(61). Bristles not continued across middle, supernumerary tufts black. *P. variolosa*, n.sp.

63(60). Fourth and sixth interstices alone granulate, the others costate. *P. breviformis*, n.sp.

viii. 64(33). Prothorax truncate in middle line at apex, no apical lobe. *P. metasternalis*, n.sp.

ix. 65(32). ♂ with inner laminæ of forceps greatly developed, and meeting at apex or overlapping.

66(67). Abdominal fascicles four in number. *P. falciformis* Macl.

67(66). Abdominal fascicles two in number.

68(69). Fascicles widely separated. *P. kosciuskoana*, n.sp.

69(68). Fascicles only moderately far apart.

70(75). Forceps greatly thinned beyond insertion of laminæ.

71(72). Laminæ meeting at apex, not overlapping. *P. impressa* Boisd.

72(71). Laminæ overlapping.

73(74). Setæ yellowish-red in colour. *P. flavoraria*, n.sp.

74(73). Setæ black. *P. Sloanei*, n.sp.

75(70). Forceps very short and obtuse beyond insertion of laminæ.

76(77). Form robust, laminæ overlapping. *P. cultrata*, n.sp.

77(76). Form subparallel, laminæ meeting at apex, not overlapping. *P. monticola*, n.sp.

x. 78(31). Anal forceps extremely short, not meeting at apices, which alone are visible; anal excavation shallow.

79(82). Abdominal fascicles present, small and situated far apart.

80(81). Elytral interstices granulate for the most part in double series. *P. abnormis* Macl.

81(82). Elytral interstices granulate for the most part in single series. *P. assimilis*, n.sp.

82(79). Abdominal fascicles absent. *P. perlata*, n.sp.

Notes on Table of the Species.—The Roman numerals represent what, in my opinion, may be regarded as distinct groups of species.

Group v.—The inclusion of *P. Mastersi* in this group is somewhat arbitrary; the costate elytra, peculiarly shaped forceps, and the absence of the interforficular process might be sufficient to entitle it to a group of its own.

P. flavosetosa also differs from the typical members of the group in the absence of the interforficular process.

The other members are all extremely closely allied.

Group viii.—*P. metasternalis* occupies an anomalous position; probably further research will show it to be one of a definite group, allied in some respects to the *P. forficulata*-group.

Psalidura mirabilis Kirby.

Kirby, Trans. Linn. Soc. xii. 1818, p.469, t.23, f.9,*a-c*; Fischer, Mém. Soc. imp. Mosc. vi. 1823, p.265, f.11; Boisduval, Voy.

Astrolabe, iii. 1835, p 381; Gyllenhal, Schönh., Gen. Curc. ii. p.470; Macleay, Trans. Ent. Soc. N. S. Wales, i. 1865, p.202; ? *P. reticulata* Boisd., Voy. Astrolabe, ii. 1835, p.384.

♂. Size moderate. Colour black, elytral granules dark red; sparingly clothed with minute greyish scales; fascicles red; nigro-setose. Head large, convex, hidden by prothorax; rostrum short, thick, rather feebly excavate, ridges flattened, basal sulci well marked; mandibles simple; mentum with a strong triangular gular horn. Prothorax (6 × 6 mm.) widest in front of middle, apex strongly produced, collar-constriction faint, median line obsolete, moderately finely granulate, granules rather larger towards sides, setigerous. Elytra (14 × 8 mm.) widest behind middle, rounded on sides; base feebly arcuate, shoulders moderately prominent; apex abruptly rounded, flanged and mucronate; disc irregularly striate, the striæ crossed by numerous transverse rugæ, interstices rather finely granulate in single series, sutural represented by a row of minute granules not thickened at base; second, fourth, and sixth finely granulate, the fourth and sixth rather irregularly so and barely reaching to base or apex; third, fifth, and seventh interstices more prominent, the granules slightly larger and extending from base to apex. Metasternum feebly concave in centre. Anal excavation deep, not quite reaching to anterior margin of the segment, preanal fossa deep, posterior edge sinuous; fascicles widely separated, situated within the excavation. Forceps rather small, transversely widened at base, setigero-punctate, laminæ short, apex projecting back. Dimensions: ♂, 20 × 8; ♀, 21 × 9 mm. These are dimensions of a small pair.

Hab.—New South Wales, Sydney, Ryde. Most of the specimens under review without locality, beyond New South Wales.

In ascribing the name *P. mirabilis* to the above species, I have followed the earlier authorities, but I am not convinced of the correctness of the identification. Kirby makes no mention of the gular horn, which he could scarcely have overlooked; and he describes the laminæ very fully, but makes no mention of the forceps, "Ex fundo cavitatis laminæ duæ, latæ, compressæ, obcuneatæ, apice rotundatæ, lævissimæ, glaberrimæ, nitidæ, emergunt." The figure of the anal excavation shows the presence of forceps and laminæ (both labelled as laminæ), and these structures are of the type met with in the species with a gular horn. The figure of the species is more like that of a member of the *P.-impressa*-group. In the event of such proving to be the case, it would be necessary to name this present species *P. reticulata* Boisd., but until the type can be examined it may be better not to do so.

PSALIDURA RUFOLINEATA W. Macleay, *loc. cit.*, p.203.

♂. Size moderate, of an oblong elongate form, convex. Black, elytral granules red; very sparingly clothed with minute grey scales. Head and rostrum as in *P. mirabilis*, gular horn present. Prothorax(7 × 7 mm.), rounded on sides, widest in front of middle, apex strongly produced; disc feebly depressed, finely granulate, the granules finer and closer together than in *P. mirabilis*, larger at sides and along collar-constriction. Elytra(15 × 9 mm.), feebly rounded on sides, base feebly arcuate, shoulders thickened but not tuberculiform; regularly foveo-striate, foveæ moderately distinct, smaller and closer together, and separated by less conspicuous rugæ than in *P. Coxi*; interstices regular, the third, fifth, and seventh more conspicuous and rather more coarsely granulate, tending in places to be duplicated; the others finely granulate, all the interstices reaching to the base, the fourth becoming obsolete posteriorly. Anal excavation deep, the preanal fossa deeply sunken, fascicles widely separated. Forceps strong, slightly longer than in *P. mirabilis*, transverse at base, the laminæ not quite meeting, their apices projecting backwards. Dimensions: ♂, 22 × 9; ♀, 20 × 9 mm.

Hab.—New South Wales; Newcastle district, Hunter River (Macleay Museum).

Very close to *P. Coxi* and *P. mirabilis*, of either of which it might perhaps be regarded as an extreme variety. The chief points of difference from *P. Coxi* are its smaller size, and its finer prothoracic granulation and elytral sculpture. These differences, however, though evident between typical specimens, are less obvious between the different varieties of the two species. From *P. mirabilis*, it differs in its more regular elytral sculpture, and and slightly longer forceps.

PSALIDURA COXI Macleay, *loc. cit.*, p.204.

♂. Form large, robust, convex. Black, elytral granules black or dull red; sparingly clothed with greyish scales; nigro-setose. Head large, convex, overlapped by prothorax, rostral grooves as in *P. mirabilis*; mandibles simple; gular horn present. Prothorax(9 x 8 mm.) large, evenly rounded on sides, apex strongly produced, collar-constriction faint; feebly depressed on disc, granules rather coarser than in *P. mirabilis* and somewhat flattened. Elytra(17 x 11 mm.) robust, rather feebly rounded on sides, shoulders not prominent; disc regularly foveo-striate, foveæ small, separated by well defined transverse rugæ; interstices prominent, regular, all reaching to base, the fourth not quite reaching apex; the third, fifth, and seventh more prominent, and slightly more coarsely granulate. Anal excavation barely reaching anterior margin, fossa very deep; fascicles widely separated, situated within the excavation. Forceps somewhat larger than in *P. mirabilis*, transversely widened at base; laminæ moderately long, almost touching; apex projecting backwards. Dimensions: ♂, 25 x 11; ♀, 25 x 11 mm.

Hab.—Mudgee, Coonabarabran (Macleay Museum); Wollondilly River(Rainbow).

VAR. A.—Differs in being smaller(♂, 22 x 9 mm.), but has the same robust form and the regular elytral sculpture; the transverse rugæ are, however, smaller and not so prominent as in typical specimens.

Hab.—Tamworth(Musson).

VAR. B.—Slightly smaller than the type (♂, 24 x 9·5 mm.), and of a somewhat flatter form; the elytral granules of a light red, tending on the third and fifth interstices to be duplicated. Transverse rugæ low.

Hab.—Blue Mountains, Wolgan Valley(H. J. Carter).

The three foregoing species, *P. mirabilis*, *P. rufolineata*, and *P. Coxi*, form a triad of species so closely allied that, while it is possible to point to outstanding types of each, yet intermediate specimens run each other so close that it is well nigh impossible to clearly define the limits of each.

P. mirabilis Kirby, has the elytral sculpture more irregular and confused, the granules on the intermediate interstices detached from one another, and, as a rule, not continued to the base or apex.

P. rufolineata Macleay, has the elytral sculpture finer than in *P. Coxi*, and more regular than in *P. mirabilis*. The prothoracic granulation also affords a point of distinction; in *P. rufolineata* it is rather finer and closer than in *P. mirabilis*. The forceps are slightly stronger than in *P. mirabilis*.

P. Coxi Macleay.—Typical examples of this species are much larger than those of the other two species, and have the elytral sculpture more regular, the transverse rugæ being much larger, and more prominent; the prothoracic granules are, as a rule, larger than in the other species, but the last feature varies in different specimens, especially in the female. The forceps are larger and stronger than in *P. mirabilis*.

P. reticulata Boisd.—The type is a female, but undoubtedly belongs to this group; unfortunately it is not absolutely possible to refer it either to *P. mirabilis* or to *P. rufolineata*; it has the prothoracic granulation fine, as in *P. rufolineata*, but the elytral sculpture is exactly as in female specimens of *P. mirabilis*, the granules being separate and nowhere duplicated.

While I think it well, for convenience, to retain both *P. rufolineata* and *P. Coxi* as species distinct from *P. mirabilis*; it is highly possible that they should be considered as varieties only.

P. reticulata Boisd., I place as a synonym of *P. mirabilis*, with only a slight degree of hesitation.

The other members of the "gular-horn-group" can be distinguished without trouble, *P. verrucosa* by its extremely coarse prothoracic and elytral granulation, and *P. cancellata* by its peculiar costate elytra. There are, however, several other species having more or less fully costate elytra, and some of these are closely allied, one of them being described in the present paper as *P. costipennis*.

PSALIDURA VERRUCOSA Macleay, *loc. cit.*, p.203.

♂. Large, robust, convex. Head completely overhung by prothorax; rostrum short, thick, basal grooves deep; mandibles simple, a short gular horn present. Prothorax ($8\frac{1}{2} \times 8\frac{1}{2}$ mm.) angularly dilate on sides, median lobe strongly produced, coarsely granulate, the granules being few in number, large, rounded, and discrete. Elytra(18 × 11 mm.) evenly rounded on sides, the apex feebly mucronate, humeral angles marked but not prominent, disc longitudinally striate, not definitely foveate, interstices coarsely granulate, granules elongate, feebly flattened, much finer on the sutural interstice, on all the interstices continuous from base to apex; fifth ventral segment widely and deeply excavate, extending to the anterior margin; fossa deep, slightly transverse; fascicles small, situated far apart(4 mm.) within the excavation. Forceps strong, transverse at base, laminæ moderately large, apices almost meeting and projecting angularly backwards. Dimensions: ♂, 27 × 11 mm.

Hab.—Australia(Macleay Museum); New South Wales, Uralla, Armidale(W. W. Froggatt), Walcha(E. W. Ferguson). Type in Macleay Museum.

The coarsely granulate prothorax and elytra will distinguish this species from the other members of the armed-throat group, or indeed from any of the genus. The specimens from New England differ from Macleay's type in being slightly smaller, and in not having all the elytral interstices evenly granulate, *e.g.*, the granules on the second and sixth being wanting at the base, and on the fourth only present on the middle; in my opinion they represent only a variety.

PSALIDURA CANCELLATA, n.sp.

♂. Of an ovoid, elliptical form, convex. Head armed with gular horn; prothorax strongly produced in front and coarsely granulate. Elytra foveo-reticulate, interstices costate, fourth and sixth obsolete, subsutural wanting in anterior half; fascicles widely separated; forceps transverse. Black, subnitid, sparingly clothed in elytral foveæ with minute cinereous scales. Setæ black, abdominal fascicles dark brown.

Head large, convex, almost completely hidden by prothorax. Rostrum short, thick, separated from head by a transverse sulcus. External ridges parallel, separated from internal ridges by an oblique groove posteriorly. Internal ridges low, separated by median notch. Emargination moderate. Mandibles rounded, inner glabrous portion projecting slightly beyond outer, which is opaque and clothed with long black setæ. Strong gular horn projecting back from mentum, tongue-shaped as viewed from in front, triangular from the side. Prothorax longer than wide (8 × 7 mm.), broadest in front of middle, rounded to base and apex; median lobe strongly produced, overhanging head; disc somewhat flattened, with a feeble collar-constriction anteriorly and an ill-defined median impression. Coarsely granulate, granules round, feebly flattened, each bearing a minute black seta. Elytra oblong, convex, strongly declivous(15·5 × 9 mm.). Sides evenly widened from base to behind middle; apex abruptly rounded, mucronate; base slightly arcuate, thickened at shoulders, but not tuberculiform. Striæ three in number, very broad, equal (excepting the apical portion of the first, which is subdivided into two) to the width of two ordinary striæ, transversely foveate, the ridges between the foveæ transverse, wavy, and each bearing two minute setæ. Interstices costate, narrow, prominent, first only present in anterior half, thence turning outwards to form the second or subsutural costa, which is only present in posterior half; third, fifth, and seventh present in entirety, fourth and sixth completely wanting. Sides transversely rugose, with median longitudinal ridge. Metasternum shallowly concave. Fifth ventral segment strongly excavate, the excavation reaching to anterior margin, preanal fossa deep, transverse, marked off in front by an overhanging ridge at the ends of which the widely distant(4 mm.) fascicles are inserted, posterior edge sinuous, clothed laterally with a fringe of short black hair. Forceps strong, moderately long, widened transversely at base, setigero-granulate, laminæ moderately large, almost touching the posterior end projecting backwards. Legs long, tibiæ lightly sinuate, clothed with black setæ, stronger and thicker on the under surface.

♀. Of a shorter and more oval form than ♂. Head without gular horn; prothorax(7 × 7 mm.) not so strongly produced, and without the impressions on the disc, coarsely and rather sparsely granulate. Elytra(15 × 10 mm.) more rounded on sides, and apex more produced than in ♂. Sculpture as in ♂, except that the foveæ are not so well marked, nor so regular. Undersurface convex, third and fourth ventral segments longer, fifth without excavation Dimensions: ♂, 23 × 9; ♀, 22 × 10 mm.

Hab.—New South Wales: Inverell, Glen Innes (H. J. Carter)—S. Queensland.

Psalidura costipennis, n.sp.

♂. Elongate-ovate, convex. Gular horn present; prothorax overlapping head, finely granulate; elytral interstices costate, fourth and sixth interruptedly granulate. Black, subnitid; feebly clothed with minute muddy scales, especially in the elytral striæ; setæ brown; tibiæ densely clothed with strong dark-coloured setæ.

Head convex, hidden by prothorax. Rostrum short, dilated on sides, ridges rather flat, sulci deep, median notch present, central area depressed in front; head and rostrum setigero-punctate. Mandibles simple; throat armed with a tongue-shaped, coarsely punctate horn projecting back from the mentum. Prothorax(7·5 × 7 mm.) moderately dilate on sides, and strongly produced in front in a median lobe, base truncate; collar-constriction faint, no median line present; disc closely and finely granulate, especially towards centre, the granules setigerous, and with rather a rubbed appearance. Elytra(16 × 10 mm.) strongly rounded on sides, widest beyond middle; apex mucronate, fully flanged; base truncate, humeral angles not marked. Disc convex, foveo-striate, foveæ deep and regular, slightly transverse; interstices costiform, first only costate at extreme base; second, third, fifth, and seventh prominent, costate, somewhat crenulate; fourth and sixth interruptedly granulate, the granules rather fine and in single series, traceable throughout except on declivity. Sides regularly foveo-striate. Metasternum feebly concave. Fifth ventral segment widely and deeply excavate, extending back to the anterior margin; preanal fossa deep; fascicles large, situated far apart(3·5 mm.), within the excavation. Forceps moderately long, feebly arcuate, not markedly transverse at base; laminæ rather large, directed inwards and just meeting at apex, projecting backwards. Dimensions: ♂, 23 × 10 mm.

Hab.—Queensland : Brisbane(R. Illidge).

Most nearly allied to *P. cancellata*, but abundantly distinct in having all the elytral interstices present in their entirety, and in having the second interstice fully costate. From all other described species of this group, the costate elytra will distinguish it. The prothoracic granulation is finer than in any other of the *P.-mirabilis*-group.

Psalidura miracula Macleay, *loc. cit.*, p.205.

A thoroughly distinct species, most closely related to *P. approximata*. Head and rostrum very large, mandibular horns strong and divergent. Prothorax (6·5 × 7·5 mm.) without median lobe, closely, somewhat obsoletely, granulate, median impression rather faint. Elytra(16 × 10 mm.) ovoid, shoulders not produced, apex strongly flanged and mucronate; striate, shallowly foveate, interstices costate, sutural prominent at base, outturned to join third; third and fifth prominent and reaching to base; second not reaching base; fourth not prominent, not extending beyond declivity; sixth and seventh not so prominent. Ventral excavation deep in ♂, reaching anterior margin of fifth segment; preanal fossa transverse, a prominent intermediate ridge running from posterior border to end in front of fossa, but not continuous across middle line; fascicles small, very close together, situated within excavation. Forceps long, curved, inner surfaces looking forwards as well as inwards; laminæ rather short. *Dimensions*: ♂, 23 × 10; ♀, 23 × 10 mm.

A widespread (New South Wales) species ranging from Mudgee, on the south, to Tenterfield, on the north; also a very common species on the Blue Mountains, and sent to me from Brisbane by Mr. R. Illidge. Type in the Australian Museum.

The strongly curved horns, and closely set abdominal fascicles separate this species from all others of its group, except *P. approximata*; from which, however, the larger, differently set forceps distinguish it.

PSALIDURA APPROXIMATA, n.sp.

♂. Oblong, elongated, convex. Mandibles armed, prothorax finely granulate, elytra reticulo-striate, interstices costate, abdominal fascicles closely approximated, forceps moderately long. Black, opaque, elytral foveæ sparsely cinereo-squamulose; setæ black, fascicles dark red.

Head rather feebly convex, sparsely setigero-punctate. Rostrum short, thick, excavate, external ridges prominent, subparallel, basal impressions strongly marked, median area well defined, sloping anteriorly, emargination moderate; mentum without gular horn. Mandibles large, external angles strongly produced into two curved divergent horns, inner glabrous portion narrow, outer portion opaque, furnished with long black setæ, not extending on to the horns. Prothorax moderately dilated on sides (6 × 7 mm.); sides evenly rounded, widest about middle, base truncate, apex lightly sinuate, not produced in middle, collar-constriction somewhat feebly marked near the sides; disc rather flattened, with an ill-defined median depression, mesial line only traceable posteriorly; finely granulate, granules round, discrete, rather closer together near the centre, unisetigerous. Elytra (15 × 9 mm.) elongate, not greatly wider than prothorax, convex, strongly declivous posteriorly, sides lightly widened from base to behind middle, thence subparallel to apex, apex with moderately large flange, mucronate: base truncate, shoulders marked but not produced: striate, striæ regularly foveo-reticulate; interstices costiform, third and fifth more prominent than the rest, first outturned at base to join third, obsolete posteriorly; second, fourth, and sixth tending to lose their costiform character and become granulate; fourth ending a little beyond middle. Sides transversely rugate in two rows separated by subcostate interstice. Metasternum shallowly impressed in middle. Fifth ventral segment deeply excavate, excavation steep, not reaching anterior edge; intermediate ridges prominent, ending abruptly in front of the deeply sunken preanal fossa; fascicles very small and close together, situated within the excavation at the ends of the intermediate ridges. Forceps moderate in length, not so long as in *P. miracula*, outer faces rounded, inner sides concave, directly facing one another, with no inclination forwards as in *P. miracula*; laminæ moderately large, rounded, fringed at base with dark hair. Legs long, rather thin, densely clothed with black setæ. Dimensions: ♂, 23 × 9 mm.

Hab.—Victoria(?).

I have received from Mr. A. M. Lea a single specimen of this species bearing a label "Victoria(?), F. H. du B." Among the species with armed mandibles, it is most closely allied to *P. miracula* Macleay, but differs in the prothoracic granules, distinct without any tendency to become obsolete, the elytral sculpture more regularly foveate, and the anal forceps shorter and with their inner faces directly facing; the legs, notably the posterior tibiæ, thinner and lighter. The abdominal fascicles are rather smaller and more closely set in *P. approximata*. From the other members of the group, the position of the fascicles will separate it.

Psalidura mira Bohemann.

Bohemann, Schönh., Gen. Curc. vii. (1), p.51; *P. paradoxa* Sturm, Cat. 1843, p.350, t.5, f.3,*a-d*; var. *P. mirifica* Macleay, Trans. Ent. Soc. N. S. Wales, ii., p.204.

♂. Mandibular horns rather short, not so widely divergent as in *P. miracula* Macleay. Prothorax(5 × 6 mm.) rather feebly rounded, much narrower than elytra, and not produced in front, median line and collar-constriction present; granules fine, rounded, not abraded. Elytra elongate(14 × 9 mm.), shoulders not produced, striæ regularly foveate, interstices costiform, first only marked at base; third and fifth prominent, reaching to base; second prominent, not reaching base; fourth, sixth, and seventh not so well defined; ventral excavation reaching anterior margin of the apical segment; preanal fossa deep, transverse; fascicles small, situated within the excavation, and moderately close together(1 mm.). Forceps moderately long, feebly curved, laminæ short. Dimensions : 20 × 9 mm.

In ascribing the name *P. mira* Bohem., to the above species, I have followed Sir William Macleay; Bohemann's description would, however, apply to most species of this group.

P. mirifica Macleay, is, in my opinion, a slight variety of *P. mira* Bohem.; it is slightly larger(22 × 9 mm,), and has a more subparallel form, the prothorax rather more sparingly granulate, the elytra more parallel-sided, the striæ broader and more deeply foveate, and the interstices not so prominent; the anal excavation is as in typical specimens, but the fascicles are slightly differently set, and the forceps thicker, and more feebly curved than in *P. mira*.

This species is not from Swan River, as recorded by Macleay, but is from the neighbourhood of Sydney, N.S.W. I have *P. mirifica* Macleay, from Conjola, N.S.W.

I have not seen the description of *P. paradoxa*, and know it only from the reference in Masters' Catalogue.

Psalidura Carteri, n.sp.

♂. Of an elliptical-ovate, widely dilated form, convex. Mandibles armed; prothorax granulate, abraded on disc; elytra striate, foveo-reticulate, interstices costate; fascicles large, widely separated, forceps moderately long. Black, shining; sparingly clothed with minute cinereous scales in the elytral foveæ; abdominal fascicles reddish-brown, setæ black.

Head large, not overhung by prothorax, lightly convex, sparingly punctate. Rostrum short, thick, ridges prominent, setigero-punctate, lateral basal sulci deep, median notch present, median area depressed, emargination moderately deep. Mandibles strong, external angles each produced into a short horn, horns subparallel, outer opaque portion of mandibles densely clothed with long black setæ. Prothorax(6·5 × 7·5 mm.) slightly transverse, sides rounded, widest a little in front of middle, apical median lobe hardly produced, collar-constriction well marked, base truncate; disc feebly convex with a rounded somewhat irregular central depression, median line traceable in its entirety; granulate, granules fine, distinct only at sides behind and in front, elsewhere on disc the granules are completely abraded, leaving a smooth tessellated surface. Elytra(17·5 × 10·5 mm.) oblong-ovate, convex, strongly declivous, much wider than prothorax; sides greatly widened from base to beyond middle, thence subparallel to apex which is abruptly rounded, with a wide corrugated flange, and mucronate; base truncate, humeral angles not produced; disc foveo-striate, foveæ deep, regular, separated by transverse setigerous ridges, interstices prominent, forming seven distinct costæ, first thickened at base and outturned to join the third, less prominent posteriorly; second, third, and fifth most prominent, fourth ending in front of declivity, sixth and seventh not so prominent; costæ with only a few scattered setigerous punctures; sides rugosely corrugate, with an ill-defined central ridge. Metasternum widely and somewhat shallowly concave. Fifth ventral segment deeply excavate, excavation extending to anterior margin, preanal fossa deep, separated from rest of excavation by a well marked intermediate ridge continuous across middle line; posterior edge fringed at sides with black hair; abdominal fascicles broad, widely separated(3 mm.), situated within excavation. Forceps strong, moderately long, gently curved inwards; laminæ situated near base, rounded, not meeting, fringed with short black hair along outer side of attachment to forceps. Legs moderately long, tibiæ clothed with black setæ, stouter along the under side.

♀. Of a much smaller, more rotundate-oval form. Mandibles simple, rounded in front, rugulose, and with short black setæ;

head and rostrum as in ♂. Prothorax(5 × 6 mm.) without median line and discal depressions of ♂, abrasion of the granules confined to a few of the central granules which present the appearance of having run together. Elytra almost globulose, widest beyond middle, much wider than prothorax(13·5 × 9·5 mm.); apex rounded, moderately produced; foveo-striate, foveæ regular, deep, interstices equal, well formed, costate. Under surface slightly convex, first ventral segment with shallow oblique impression on either side meeting in front, second segment about length of third and fourth combined, third and fourth longer than in ♂, fifth not excavate, slightly convex, segments two to five all having ill-defined impressions on either side of median line. Legs diluted with red. Dimensions: ♂, 25 × 10·5; ♀, 20 × 9·5 mm.

Hab.—Mt. Kosciusko(H. J. Carter).

The shining black colour, regularly foveate, widely dilated elytra, and abraded prothorax will distinguish this species from most of its allies of the group with armed mandibles. Besides *P. amplipennis*(q.v.), it is most nearly allied, in the abraded prothorax, and broad, widely separated fascicles, to *P. sublævigata*, but in general appearance it is quite unlike that species; from *P. miracula* Macleay, it is still more distinct. I have much pleasure in dedicating this fine species to Mr. H. J. Carter, who discovered it, among other novelties, on Mt. Kosciusko, and to whom I am indebted for much valued advice, and generous encouragement.

Psalidura amplipennis, n.sp.

♂. Of an elongate-ovate form, convex. Jaws armed, prothorax abraded, elytra foveo-striate, interstices costate, fascicles small, forceps moderately long. Black, shining, sparingly clothed with minute muddy scales in elytral foveæ; nigro-setose; fascicles brown.

Head rather feebly convex, forehead running on to rostrum without break, when viewed from the side; a deep median groove in the forehead not extending to vertex. Rostral ridges well defined, lateral basal grooves deep, median notch present, continuous with linear frontal impression, median area depressed in front behind marginal plate. Mandibles with external angles produced into two strong divergent horns. Prothorax(6 × 6·5 mm.) gently rounded on sides, anterior margin sinuous at sides, practically no median lobe; disc depressed in centre, median line somewhat ill-defined; granules abraded in disc, traceable though flattened on sides, along basal margin, and along the position of the collar-impression; setæ minute. Elytra(15 × 10 mm.), sides rounded, dilated posteriorly, widest behind middle; apical flange prominent, apex mucronate; base truncate, humeral angles rectangular, not produced. Disc foveo-striate, foveæ deep, regular, transverse, separated by well defined transverse costæ; interstices costate, second, third, and fifth most prominent, sutural slightly thickened at base, not joining third; second and fourth showing tendency to be broken up into granules on the declivity, costæ sparingly setigero-punctate. Sides regularly foveate in two striæ. Metasternum feebly convex, almost flat. Fifth ventral segment deeply and widely excavate as far forwards as the anterior margin; preanal fossa deep, separated anteriorly by a well defined edge extending across middle line; fascicles small, about 1·5 mm. apart, situated within excavation; posterior edge strongly sinuous. Forceps moderately long, evenly curved, and meeting at apex; laminæ small, rounded at apex, and fringed with black hair along outer side. Legs moderately long, nigro-setose. Dimensions : ♂, 22 × 10 mm.

Hab.—Queensland : Darling Downs(R. Illidge).

Most closely allied to *P. Carteri*, but a smaller species, with the elytral sculpture somewhat different, and differing widely in the size and position of the abdominal fascicles. I am indebted for my unique specimen to the generosity of Mr. R. Illidge, Brisbane.

PSALIDURA SUBLÆVIGATA, n.sp.

♂. Elongate-elliptical, convex. Mandibles armed, prothorax granulate, abraded on disc, elytra shallowly foveo-striate, costate, fascicles widely separated, forceps moderately long. Black, opaque, elytral striæ sparingly clothed with greyish scales, abdominal fascicles red, setæ black.

Head flattened in front; external rostral ridges continued back to forehead, basal rostral grooves well marked between external ridges, emargination moderately deep. Eyes large, oval. Mandibular horns short, subparallel. Prothorax slightly wider than long($6 \times 6 \cdot 5$ mm.), widest in front of middle, anterior margin sinuous, no definite median lobe, collar-constriction feeble; median line traceable throughout, widened in middle to form a shallow depression; granulate, granules fine, abraded on disc, distinct on sides, behind, and in front. Elytra elongate, much wider than prothorax($15 \times 9 \cdot 5$ mm.), gradually widened to behind middle, thence subparallel to apex; apex abruptly rounded, mucronate; base widely emarginate, humeral angles not produced; disc foveo-striate, foveæ shallow, somewhat irregular, transverse ridges low, not well defined; interstices costate; second, third, and fifth most prominent, sutural thickened and outturned at base to join third; second, fourth, and sixth not quite reaching base, fourth ending in front of posterior declivity. Sides foveo-striate, interstices subcostate. Undersurface: metasternum shallowly concave. Fifth ventral segment deeply and widely excavate, excavation reaching to anterior margin between the fascicles, preanal fossa deep, transverse, marked off in front by a well defined ridge; posterior edge clothed at sides with a fringe of short black hair; fascicles large, broad, moderately far apart (2 mm.), situated within excavation. Forceps strong, moderately long, gradually incurved; laminæ rather small, rounded, situated near base, fringed along outer side of attachment with black hair. Legs clothed with black setæ intermingled with lighter-coloured scales on tibiæ; setæ stronger on under side.

♀. Of a shorter, more oval form than ♂. Head and rostrum as in ♂, but mandibles simple, not armed; prothorax($5 \times 5 \cdot 5$ mm.) much less abraded on disc; elytra (13×8 mm.) oval, apex rounded, not mucronate, foveo-striate, foveæ very shallow and irregular, interstices costiform, not so prominent as in ♂; undersurface feebly convex, third and fourth ventral segments longer than in ♂, apical segment simple, not excavate, but with a shallow impression on either side. Dimensions: ♂, $22 \cdot 5 \times 9 \cdot 5$; ♀, 19×8 mm.

Hab.—New South Wales : Mittagong(E. W. Ferguson).

In the abraded prothorax and form of the abdominal fascicles most nearly allied to *P. Carteri*; but, in general appearance, closer to *P. mira*; that species may, however, be distinguished by having the abdominal fascicles closer and much smaller, and by the prothorax not abraded. From *P. Carteri*, its smaller, much less dilate form, and its opaque colour, as well as its differently sculptured elytra will serve to separate it. *P. amplipennis* may be distinguished by its shining colour and differently situated and smaller fascicles.

Psalidura subcostata Macleay, *loc. cit.*, p.206.

An aberrant member of the *P.-mira*-group; in general appearance close to the finely granulate members of the genus. I have retained it in its present group partly on account of the presence of mandibular horns and partly because of the formation of the anal excavation. The horns are short and slightly divergent. Prothorax strongly dilated(6 × 7·5 mm.) and produced anteriorly in a median lobe, disc feebly depressed, collar-constriction moderate, very finely setigero-granulate. Elytra (13 × 8 mm.) subparallel, shoulders prominent, tuberculiform; longitudinally striate, striæ shallow, separated into foveæ by a row of low granules, interstices finely granulate; first, third, and fifth in double, the others in single series, duplicated in places. Anal excavation reaching to anterior margin, preanal fossa deep, fascicles small, red, moderately close. Forceps short, moderately curved, laminæ short. Dimensions : ♂, 20 × 8 mm.

Hab.—Parramatta.

A rare species. The type, in the Macleay Collection, is apparently somewhat abraded. Other specimens are in the Macleay Museum and Rev. Canon King's Collection.

Psalidura amplicollis, n.sp.

♂. Elongate-oblong, convex. Prothorax widely dilated, finely granulate; each elytron with three broad sulciform striæ, interstices costate; forceps short, laminæ minute, fascicles widely separated. Black, opaque; sulci with very minute sparse grey scales, setæ dark brown, fascicles red.

Head large, strongly convex, minutely rugulose, forehead and rostrum sparingly setigero-punctate. Rostrum short, thick, excavate, external ridges prominent, internal short, basal grooves and median notch well marked. Mandibles simple, inner glabrous portion produced into a blunt point. Prothorax (9 × 9 mm.) widely dilated in front of middle, narrowed to base and apex, median lobe strongly produced, the whole having from above a pentagonal appearance. Disc flat, feebly depressed in centre, with a well defined median line and strongly marked collar-constriction; finely and densely setigero-granulate, granules rather fewer and coarser on sides and about collar-constriction. Elytra oblong, subquadrate(16 × 9·5 mm.), not much wider than prothorax, gradually widened from base to behind middle, strongly declivous posteriorly; apex rather feebly mucronate, humeral angles prominent, tuberculiform; disc with three broad sulciform striæ, transversely and shallowly rugose, with a row of minute setæ on either side; interstices four in number, prominent, costiform, strongly setigerous, first represented by a fine row of granules, distinct only at base, the third running out into shoulder. Sides with two rows of large punctures. Metasternum flat, anterior prolongation truncate, feebly impressed. Fifth ventral segment large, strongly excavate; excavation moderately deep, not reaching anterior margin; preanal fossa deep, not separated from rest of excavation; posterior edge slightly raised, sinuous, with a fringe of short stout bristles on either side; fascicles moderately far apart(3 mm.), situated within excavation. Forceps short, apices rather thin, meeting in middle line, greatly dilated at base, with an obtuse projection on inner edge; laminæ very small, situated behind projection on inner edge of forceps. Legs long, slender; tibiæ lightly sinuous; intermediate tarsi with first joint somewhat dilated, inner side longer than outer, outer edge sinuous; posterior tarsi with first joint strongly dilated on inner side, outer edge almost straight.

♀. Of a shorter, more parallel form than ♂; prothorax (6 × 7 mm.) not dilated on sides, disc convex, with very feeble collar-constriction and median line; elytra(14 × 9 mm.) more contracted posteriorly, not abruptly truncate, sculpture as in ♂, but interstices ending about half-way down declivity; undersurface feebly convex, almost flat; apical segment with a deep round median pit; legs moderately long, tarsi simple. Dimensions: ♂, 23·5 × 9·5; ♀, 22 × 9 mm.

Hab.—Queensland, Dalveen(R. Illidge)—S. Queensland(T. G. Sloane)—New South Wales, Tenterfield(H. J. Carter).

One of the most distinct species in the genus; with the exception of *P. sulcipennis* not close to any I am acquainted with. Apparently it is a common South Queensland insect.

Psalidura sulcipennis, n.sp.

♂. Form briefly elongate, subquadrate, convex. Prothorax finely granulate; each elytron with three sulciform striæ, interstices costiform; fascicles moderately close; forceps extremely short, not meeting. Black, opaque, sparingly clothed in sulci with minute blackish scales, a patch of grey scales on metasternum and first ventral segment, and another on second ventral segment; setæ black; abdominal fascicles black.

Head strongly convex, minutely rugulose, forehead setigero-punctate. Rostrum short, deeply excavate anteriorly, external ridges prominent, internal ridges moderately long, median area strongly depressed, basal grooves deep, median notch small, emargination very deep. Mentum sparingly bearded; mandibles simple. Prothorax transverse(6 × 7 mm.), roundly dilated on sides, median lobe feebly produced; disc flattened, depressed in centre, with well marked mesial groove and collar-constriction; finely granulate, granules discrete, somewhat larger on sides and along collar-constriction, setigerous. Elytra oblong(12 × 8 mm.), wider than prothorax; sides gradually widened to behind middle, strongly declivous, apex broadly flanged, very feebly mucronate; base truncate, shoulders thickened, not very prominent; disc with three broad sulci on each elytron, striæ marked with transverse ridges running up on either side on to the interstices; interstices four in number, costiform, becoming granulate on declivity, setigerous in single series; sutural interstice thickened and outturned at base, elsewhere represented by a fine row of granules; third interstice humeral; sides irregularly granulate. Metasternum feebly concave, anterior prolongation rounded. Fifth ventral segment rather shallowly excavate, excavation reaching to anterior margin only in middle line, the margins of the excavation not well defined, preanal fossa present but not sharply marked off from rest of excavation; posterior border fringed across middle line; fascicles moderately close(1 mm.), thin, long, and black, situated on edge of excavation. Forceps extremely short, thick, not meeting at apex, and hardly produced beyond dorsal tergite, laminæ narrow, present along inner sides. Apical tergite projecting between forceps, coarsely punctate. Legs densely clothed with black setæ, longer and stouter on under side, tarsal joints not dilated as in *P. amplicollis*.

♀. Head as in ♂, mandibles simple; prothorax subquadrate (5 × 6 mm.), not depressed in centre, with median line fainter; granules somewhat coarser than in ♂, and not abraded; elytra (11 × 8 mm.) more gradually rounded from behind middle to apex; interstices showing greater tendency to granularity, the transverse ridges extending across the sulci; undersurface slightly convex; fifth ventral segment large, not excavate, with a shallow impunctate fovea in centre. Dimensions: ♂, 18 × 8; ♀, 18 × 8 mm.

Hab.—New South Wales, Blue Mountains (Blackheath, Katoomba, Leura).

A short, subquadrate species, belonging, at first sight, to *Talaurinus*, but with all the characters of a true Psalidura. The forceps are peculiar, in being very short and stumpy, and not meeting at the apex. It is most closely allied to *P. amplicollis*, from which its smaller size, and different anal appendages will separate it.

Psalidura elongata Macleay, *loc. cit.*, p.207.

♂. Densely clothed with greyish scales, varying to brown, setæ dark brown, granules not clothed, unisetigerous, anal hair reddish.

Head strongly convex, rostral ridges not prominent. Prothorax (7 × 7 mm.) moderately produced, collar-constriction well marked, finely granulate, the granules being finer and closer together in the centre. Elytra (16 × 10 mm.) elongate, base arcuate, shoulders tuberculiform, striæ somewhat irregular, crossed by numerous low setigerous ridges; interstices irregularly granulate in double series except on fourth and sixth. Metasternum elevated on either side of middle, behind middle coxæ. Anal excavation reaching anterior margin of segment, preanal fossa deep, rounded, the posterior edge of the segment forming a projecting ridge ending abruptly on either side of the fossa; fascicles close together, situated on edge of excavation. Forceps long, evenly curved, tapering from base to apex; penis with the outer angles produced outwards in a curved manner. Dimensions: ♂, 23 × 10; ♀, 23 × 10 mm.

Hab.—New South Wales: Young, Grenfell, Yass, Monaro, Orange, Narromine.

Type in Macleay Museum.

In general appearance close to *P. squamigera* Macleay, but differing in the anal excavation and forceps. A widespread species over the country lying along, and to the south, of the main Western Line; to the north its place is taken by *P. squamigera.* The more western specimens differ somewhat from the eastern in the shape of the anal excavation; in the more typical specimens (*e.g.*, the Grenfell specimen) the projection downwards of the posterior edge is much more marked than in the western forms (*e.g.*, the Narromine specimen), and the inner ends of the projection come closer together so that the hiatus between is more abrupt, and not so open.

PSALIDURA SQUAMIGERA Macleay, *loc. cit.*, p.212.

♂. An elongate, subparallel species, distinctly clothed with muddy-grey scales, the granules not clothed; setæ yellow.

Head convex, rostral ridges defined but not prominent. Prothorax (6 × 6·5 mm.) evenly rounded on the sides, moderately produced in front, without evident collar-constriction, median line feeble, densely and finely granulate. Elytra(15 × 9 mm.) subparallel, shoulders prominent, regularly striate, the striæ each with a row of minute granules running down the centre, interstices finely and closely granulate in double series except the fourth and sixth. Undersurface rather deeply concave over the metasternum and first two abdominal segments, the metasternum with a projection on either side behind the middle coxæ. Apical excavation somewhat shallower than usual, the preanal fossa open, posterior edge thickened at base of forceps on each side, fascicles very small and close together, separated by a prolongation forwards of the excavation. Forceps short, strongly arcuate, thickened at the base, the laminæ short but prominent, their apices strongly rounded. Dimensions: ♂, 22 × 9; ♀, 23 × 9 mm.

Hab.—Coonabarabran(T. G. Sloane), Quirindi(Bryant).

Type in Macleay Museum.

Of about the size and general appearance of *P. elongata* Macleay, but readily distinguished by the shorter, more strongly arcuate forceps; the anal excavation is also more open, and the preanal fossa not sharply marked off. It is more closely allied to *P. subvittata* and *P. montana*, from both of which its larger size will distinguish it.

PSALIDURA MONTANA Macleay, *loc. cit.*, p.209.

♂. A small black species, clothed with muddy-brown scales not obscuring the granules; setæ dark brown.

Head small, convex, rostrum not deeply excavate, ridges most prominent at base. Prothorax (5 × 5 mm.) rounded on sides, moderately produced, disc very finely granulate. Elytra subparallel, shoulders slightly thickened, not prominent; striæ crenulate, not definitely foveate, interstices finely and somewhat irregularly granulate in double series except on the fourth and sixth. Metasternum with a tubercle on either side of the middle behind the middle coxæ; excavation shallow, the preanal fossa not separated from the rest of the excavation; fascicles small, close together; forceps small, strongly arcuate; laminæ short, rounded at apex. Dimensions: ♂, 17 × 7; prothorax 5 × 5; elytra 12 × 7 mm.

Hab.—Queensland. Type in Australian Museum.

Closely allied to *P. subvittata*, from which it differs in having the prothorax more finely granulate, in the elytral granules not obscured by the clothing, and in the colour of the clothing. From *P. squamigera* Macl., its smaller size and finer granulation will separate it.

PSALIDURA SUBVITTATA Macleay, *loc. cit.*, p.211.

♂. A small narrow species, densely clothed with black and grey scales, prothorax trivittate, elytra maculate, the dark patches being more pronounced on either side of the suture, granules clothed; nigro-setose.

Head rather small, inner rostral ridges more prominent at base. Prothorax as long as wide(5 × 5 mm.), the mesial lobe produced, closely and finely granulate except along mesial line. Elytra (12 × 7 mm.) feebly rounded on sides, humeral angles slightly thickened, foveo-striate, interstices not prominent, setigero-granulate in double series except on fourth and sixth, granules obscured by clothing. Undersurface feebly concave. Metasternum with marked projection on either side behind middle coxæ. Fifth segment excavate, the excavation not quite reaching anterior margin; preanal fossa not marked off from rest of excavation; fascicles minute, close together, situated on margin of excavation; forceps small, strongly arcuate; laminæ short, apices rounded. Dimensions: ♂, 18 × 7; ♀, 18 × 7 mm.

Hab.—Queensland: Wide Bay, Ipswich, Gympie.

Close to *P. squamigera* Macl., and *P. montana* Macl.; from the first of them, its small size, clothing obscuring the granules, etc., will separate it; from *P. montana*, the nature of the clothing is distinctive.

PSALIDURA MASTERSI Macleay, *loc. cit.*, p.214.

P. reticulata Macl., (nec Boisduval), *loc. cit.*, p.214.

♂. Elongate-ovate; black, shining, nigrosetose.

Mandibles feebly toothed, not produced into a horn; rostral sulci forming a horseshoe-impression encroaching on forehead. Prothorax(6 × 7 mm.) evenly rounded, finely and closely granulate, no median impression, apical lobe feebly produced. Elytra(15 × 8 mm.) evenly rounded on sides, the apex narrower than the base and feebly flanged, basal angles prominent, disc foveo-striate, the foveæ deep and regular, giving elytra a reticulate appearance; interstices costate, all present in entirety, and all equally prominent except the sutural. Anal excavation not quite reaching anterior margin of apical segment; preanal fossa transverse, rather shallow, fascicles small, black, situated well within the excavation, and moderately far apart(2 mm.); forceps long, almost straight, very thin and tapering to a point, laminæ linear. Dimensions: ♂, 22 × 8; ♀, 22 × 9 mm.

Hab.—New South Wales: Wellington, Mudgee (Macleay Museum)—Queensland: Ipswich(Macleay Museum).

This insect is of a deep shining black colour, without apparent clothing, and sparingly setose; the elytral sculpture is very regularly reticulate; the long straight forceps are very characteristic, and are unlike those in any other species known to me. The specimen regarded by Sir W. Macleay as *P. reticulata* Boisd., is a female of this species; Boisduval apparently adopted the name from a specimen in the Macleay Collection, but his type, which I have examined, is certainly not the same as *P. Mastersi* Macleay.

PSALIDURA FORFICULATA Macleay, *loc. cit.*, p.210.

Talaurinus incertus Macl., *loc. cit.*, p.221.

♂. A rather short species, densely clothed with scales varying from grey to brown. Prothorax(6 × 6 mm.) strongly rounded on sides, produced in front, and with well marked collar-constriction, finely granulate. Elytra (13 × 8 mm.) subparallel from shortly behind shoulders, shoulders themselves tuberculiform, striæ rugose, not definitely foveate; interstices finely granulate in double series excepting the fourth and sixth, granules not clothed. Metasternum rugulose. Anal excavation not extending to anterior margin of segment; preanal fossa transverse, posterior edge with two lamellar projections between the bases of the forceps; fascicles thin, close together (1 mm.), situated within the excavation; forceps long, feebly curved; laminæ linear, obscured by a fringe of yellow scales. Dimensions: ♂, 20 × 8; ♀, 19 × 8mm.

Hab.—Rockhampton, Dalveen, Queensland. Type in Macleay Museum.

I have carefully examined the type of *T. incertus* Macl., on several occasions; it is, as conjectured by Macleay, a female Psalidura. There are several species closely allied, which are found at Rockhampton; and the females of these are hard to distinguish; but I am convinced of the correctness of the above synonymy. From the description, I am of the opinion that *T. phrynos* Pasc., will also prove to be synonymous.

This species may be taken as the type of a large group of species of *Psalidura* located in Queensland, and distinguished by the possession of very long forceps, with laminæ linear or apparently absent. The present species differs from all, except *P. Mitchelli* and *P. cuneicaudata*, in having the fascicles situated well within the excavation; the other two are abundantly distinctive in other respects.

Psalidura Mitchelli Macleay, *loc. cit.*, p.210.

♂. Size large, form elliptical-ovate, sparingly clothed with muddy-brown scales, nigro-setose.

Head large, convex, inner rostral ridges most prominent at base. Prothorax rounded on sides, moderately produced in front, collar-constriction well marked, closely granulate, the granules somewhat coarser than in *P. forficulata*. Elytra widely ampliate, width greatest just beyond middle; apex strongly mucronate, base emarginate, shoulders not prominent, striæ irregularly crenulate, not definitely foveate; interstices irregular, rather coarsely granulate in double series, except on the fourth and sixth, granules umbilicated, setigerous. Metasternum convex, rugulose. Anal excavation deep, extending almost to anterior margin of segment; preanal fossa transverse, a narrow oblique groove running along excavation on either side to end anteriorly to preanal fossa, these two grooves not meeting, and not communicating with fossa; fascicles close together, situated within excavation at the inner ends of the oblique grooves; posterior edge with two lamelliform projections between blades of forceps. Forceps very long, feebly arcuate, laminæ linear, obscured from view by a fringe of yellow scales; penis bluntly pointed. Dimensions: ♂, 23 × 10; prothorax 7 × 7; elytra 16 × 10 mm.

Hab.—Queensland(Mitchell's Expedition). Type in Australian Museum.

Closely allied to *P. forficulata*; its large size, longer forceps, and coarser granulation will distinguish it. These two species both have the fascicles situated within the anal excavation; several other species have the fascicles further apart, and situated on the margin of the excavation.

PSALIDURA CUNEICAUDATA, n.sp.

♂. Elliptical-ovate, convex. Prothorax finely granulate, elytra striate, interstices finely granulate; fascicles close; forceps stout, moderately long, laminæ linear. Black, opaque, densely clothed with fine muddy-yellow scales; fascicles dark brown; setæ dark brown.

Head convex, partially concealed, sparingly setigerous. Rostrum short, ridges rather flat, basal impressions not very deep, median notch present, a wide semicircular impression behind marginal plate. Mandibles with outer portion lipped in front. Prothorax as broad as long(7 × 7 mm.), evenly rounded on sides, median lobe moderately produced, collar-constriction feeble, median line traceable at base; finely granulate, granules discrete, rather closer in centre, setigerous. Elytra(15 × 10 mm.) elongate-oval, gently rounded on sides, roundly declivous; shoulders prominent, tuberculiform, apex mucronate; striate, striæ shallow, with low transverse ridges, interstices narrower than striæ, setigero-granulate, granules fine, arranged in double series, except on fourth and sixth interstices, apical portion of sutural, and apical and basal portions of second also granulate in single series. Sides irregularly granulate. Metasternum shallowly concave, transversely rugulose. Fifth ventral segment excavate, excavation rather shallow, its limits ill-defined, reaching to anterior border; preanal fossa transverse, sharply separated from rest of excavation; posterior edge produced downwards in centre into a bidentate lamellar process; fascicles short, stout, close together (1 mm.), situated within excavation. Forceps stout, moderately long, triangular on section, with well marked outer border separating an anterior from a posterior surface; lamellæ linear, concealed from in front by border of yellow scales. Legs moderately long, densely clothed with light-coloured setæ, intermingled with others of a darker hue.

♀. Of a more rounded oval form than ♂; mandibles simple; median prothoracic lobe not quite so marked(6 × 7 mm.), and median line absent; elytra(15 × 9 mm.) more rounded on sides, apex more gradually produced, mucronate, shoulders not so prominent, sculpture as in ♂; ventral segments convex, third and fourth longer, fifth without excavation. Dimensions: ♂, 22 × 10; ♀, 21 × 9 mm.

Hab.—Charters Towers, Queensland.

Close to *P. forficulata*, but separated by the shallower anal excavation, and rather stouter fascicles; the forceps also are thicker, and have little of the sickle-shaped form characteristic of *P. forficulata* and *P. Mitchelli.*

PSALIDURA FOVEATA Macleay, *loc. cit.*, p.213.

♂. Form ovate, strongly dilate posteriorly, convex. Prothorax (6 × 6·5 mm.) finely granulate, much narrower than elytra, apical lobe strongly produced, collar-constriction feeble; elytra(14 × 10 mm.) rounded on sides, tuberculiform, deeply foveate, interstices irregular, granulate in double series, granules also present between the foveæ; metasternum feebly convex, rugosely punctate; anal excavation reaching to anterior margin of segment, preanal fossa deep, transverse, marked off from rest of excavation, fascicles small, moderately far apart (2 mm.), situated on the edge of the excavation, posterior edge bearded between bases of the forceps; forceps moderate in length, slightly curved, laminæ linear. Dimensions : ♂, 20 × 10 mm.

Hab.—Queensland (Macleay Museum).

The very broad, deeply foveate form of this insect is quite distinctive. From *P. forficulata*, besides shape and elytral sculpture, the more widely separated fascicles will distinguish it. It is closely allied to *P. flavosetosa*, but the elytral sculpture is very different; while *P. flavosetosa* is a much larger, robust insect. *P. Frenchi* differs in the elytral sculpture. The unique type in the Macleay Museum is the only specimen of the male I have seen; a female in the same Collection bears a label "Swan River," but this is evidently erroneous.

PSALIDURA FRENCHI, n.sp.

♂. Elongate, convex. Prothorax finely granulate; elytra striate, interstices finely granulate; fascicles moderately far apart; forceps long, laminæ linear. Black, opaque, densely clothed with minute brown scales, interspersed with lighter-coloured patches along the sides, scales on underneath parts yellowish in colour; granules not clothed, each bearing a stout, decumbent, dark brown seta; fascicles black.

Head convex, to a great extent covered by prothorax, densely clothed and setigero-punctate. Rostrum short, thick, deeply emarginate in front; basal sulci short but well marked, median area almost linear. Mandibles with the hirsute portion strongly lipped. Prothorax (6 × 6 mm.) evenly rounded on sides; apical lobe moderately produced, base truncate; collar-impression definitely marked, median line faint at base and apex; disc feebly convex, finely setigero-granulate, the granules finer and closer together towards the centre. Elytra (14·5 × 9 mm.) evenly rounded on sides; apex abruptly rounded, flanged and strongly mucronate; base truncate, humeral angles marked by a small nodule, not very prominent. Disc foveo-striate, foveæ small, shallow, somewhat irregular, each separated by a setigerous granule; interstices not very prominent, finely and rather irregularly granulate, sutural in single series duplicated at base; second, fourth, and sixth in single series, becoming double in the middle; third, fifth, and seventh more prominent, and in double series. Sides with interstices irregularly granulate. Metasternum shallowly concave, rugosely punctate. Anal excavation deep but with sloping sides, reaching not quite to anterior margin of the segment; preanal fossa deep, transverse, well marked off; posterior margin projecting downwards as a bifid process between the blades of the forceps; fascicles thin, black, moderately far apart(2 mm.), situated on the edge of the excavation. Forceps very long and arcuate, about 7·5 mm. long in external measurement; laminæ linear, obscured from in front by a thick fringe of yellow scales. Legs moderately long, feebly sinuous.

♀. Of a more rounded oval form; mandibles simple; prothorax (6 × 6 mm.) with median lobe not quite so produced; elytra (14 × 8 mm.) more rounded, and the apex more gradually produced, sculpture as in male; underneath parts feebly rounded, minutely rugulose, last segment not excavate and entirely without impressions. Dimensions: ♂, 22 × 9; ♀, 21 × 8 mm.

Hab.—Queensland, Rockhampton(C. French).

In appearance very close to both *P. forficulata* and *P. Mitchelli*, but differing from both in having the fascicles further apart, and differently situated. *P. flavosetosa*, with which it is associated in the table of species, is a much more robust insect, with rougher elytral sculpture, differently coloured setæ, etc. I have much pleasure in dedicating this species to Mr. C. French, to whom I am indebted for many specimens of Amycteridæ.

Psalidura flavosetosa, n.sp.

♂. Of an ovoid, robust form, convex. Prothorax finely granulate; elytra irregularly striate, interstices granulate; fascicles far apart, forceps very long, laminæ linear. Of a dull black colour, rather densely clothed with muddy-yellow scales; setæ pale yellow; fascicles reddish-brown. Funicle, club, tibiæ, and tarsi densely clothed with pale setæ intermingled with stronger darker ones.

Head large, strongly convex, sparingly setigero-punctate. Rostrum short, wide, excavate, internal ridges short, basal impressions deep and with median notch, median area strongly depressed in front. Mandibles densely clothed with long light-coloured setæ, outer portion lipped. Prothorax transverse (7 × 8 mm.), evenly rounded on sides; median lobe briefly produced, collar-constriction faint, no median line; densely granulate, granules discrete, rounded, rather smaller and closer in the centre, each with a single stout yellow seta. Elytra ovate, strongly declivous (17 × 10·5 mm.), evenly rounded on sides, broadest about middle; base widely emarginate, shoulders slightly produced; apex broadly flanged, mucronate. Disc striate, striæ irregular, shallow, crossed by transverse setigerous ridges; interstices convex, broad, irregular, granules umbilicated, setigerous, first interstice in single series except at base where it is doubled; other interstices in double series, tending in places to be in triple series; fourth interstice in single series at base and apex. Sides irregularly granulate. Metasternum shallowly and widely impressed, rather densely clothed with yellow setæ. Fifth ventral segment deeply excavate, excavation not reaching anterior margin; preanal fossa deep but not sharply marked off from rest of excavation; posterior edge fringed at base of forceps with short yellow hair; fascicles short, moderately widely separated (3 mm.), situated on edge of excavation. Forceps long, stout, feebly curved; laminæ very small, linear, hidden from in front by a fringe of short yellow scales. Apical tergite bicornuate. Legs moderately long, tibiæ feebly curved. Dimensions: ♂, 26 × 10·5mm.

Hab.—Victoria.

Though a member of the *P.-forficulata*-group, it is not close to any other species known to me. I have placed it in the table next to *P. Frenchi*, but its elytral sculpture will distinguish it from that species. From *P. forficulata*, it differs in its much more robust form, much coarser elytral sculpture, and in the abdominal fascicles. The absence of the bifid interforficular process will also serve to distinguish this species among the granulate members of this group.

Psalidura caudata Macleay, *loc. cit.*, p.210.

♂. Densely clothed with scales varying from grey to yellow and brown, granules shining, conspicuous; setæ yellow. Prothorax(6·5 × 7 mm.) rounded, apical lobe moderately produced, collar-constriction marked; finely granulate, granules discrete, closer and finer in the centre. Elytra(15 × 10 mm.) widest towards apex, humeral angles prominent, striæ shallow, an irregular row of granules running along the bottom of each stria; interstices finely and irregularly granulate, the granules being in single series on the fourth and sixth, and in double series on the first, second, third, fifth, and seventh interstices. Ventral apical segment deeply and broadly excavate; preanal fossa deep, rounded; fascicles small, situated on the margin of the excavation, close together. Forceps extremely long, very feebly curved; laminæ extremely short, and situated at extreme base; interforficular process strongly hirsute; penis pointed. Dimensions: ♂, 22 × 10; ♀, 22 × 9 mm.

Hab.—Queensland. Type in Macleay Museum.

A common South Queensland insect, very closely allied to *P. grandis*; the points of difference have been pointed out in reference to that species, but, apart from mere size, it is almost impossible to separate the two species on external appearances; there is also some considerable variation in size in both species, and without dissection of the penis, which may be readily done, I cannot succinctly point out the differences.

Specimens received from Mr. R. Illidge measure, ♂, 25 × 10 mm.

Psalidura grandis, n.sp.

♂. Elliptical-ovate, convex, size large. Prothorax finely granulate; elytra striate, interstices irregularly granulate; fascicles close; forceps very long, laminæ small. Black, opaque; densely clothed with fine pubescence varying in colour from white to yellow and brown; setæ yellowish-brown, fascicles and anal hair reddish.

Head broad, strongly convex, slightly overlapped by prothorax. Rostrum short, wide, ridges somewhat flattened, basal grooves rather shallow. Mandibles with outer opaque portion clothed with yellowish setæ, and produced anteriorly to form a prominent lip. Prothorax rounded, subglobular(7·5 × 8·5 mm.); median lobe feebly produced, collar-constriction well marked; disc with three lines of yellow scales, the median one most marked; granulate, granules fine, rounded, discrete, setigerous. Elytra(18 × 11 mm.) gently rounded on sides from behind shoulders, apex abruptly rounded, mucronate; base widely emarginate, shoulders prominent, tuberculiform. Disc irregularly and shallowly foveo-striate, foveæ separated by irregularly placed granules; interstices rather broad and ill-defined, finely granulate, granules prominent and shining, umbilicated, each puncture bearing a yellow seta, arranged in double series excepting on the fourth and sixth interstices, where they are in single series; sutural interstice irregular, only distinct in basal half. Sides irregularly granulate. Metasternum shallowly impressed in middle, sides slightly raised, transversely rugulose. Ventral segments: fifth large, deeply excavate, excavation not reaching anterior margin; preanal fossa deeply sunken, sharply marked off; posterior border fringed with short red hair; fascicles short, close together(1 mm.), situated just within excavation; interforficular processes of fifth segment and apical tergite meeting and supporting a tuft of reddish bristles. Forceps very long, arcuate; laminæ small, rounded and situated at extreme base; penis rounded and notched at apex. Legs moderately long, densely clothed with yellow hair intermingled with dark setæ.

♀. Of a more rounded and shorter form than ♂. Mandibles simple, head and prothorax(7 × 8 mm.) as in ♂; elytra ovate (17 × 10·5 mm.), regularly and gradually rounded on sides, apex mucronate; sculpture and clothing as in ♂; ventral segments convex, third and fourth larger, fifth not excavated. Dimensions: ♂, 27 × 11·5; ♀, 25 × 10·5 mm.

Hab.—South Queensland: Daandine(T. G. Sloane)—New South Wales: Coonamble, Kiacatoo(T. G. Sloane); Moree, Galston(A. M. Lea).

Closely allied to the preceding species, from which, however, I regard it as distinct; the size is, as a rule, larger than that of *P. caudata*, and the form relatively more robust. The chief differences, however, lie in the sexual characters of the male; in *P. grandis* the preanal fossa is rather deeper, and the blades of the forceps more arcuate in form, so that the space between the blades is wider than in *P. caudata*, in which the blades are more nearly parallel; the penis in *P. caudata* is sharply pointed, while in *P. grandis* it is rounded, and with a distinct notch in the apex. For obvious reasons I have not been able to dissect out the penis in the type-specimen of *P. caudata*, but I do not think I am wrong in my identification.

PSALIDURA WILCOXI Macleay, *loc. cit.*, p.209.

♂. A short, almost parallel-sided species, the smallest known to me; sparingly clothed with greyish scales, setæ stout, dark brown.

Head convex, rostrum rather narrow between the ridges, the sides strongly dilated, mandibles lipped. Prothorax(5 × 5 mm.) rounded on sides, moderately produced in front, collar-constriction slight, finely and closely granulate. Elytra(11 × 7 mm.) gently rounded on sides, shoulders prominent; striate, irregularly foveate, interstices setigero-granulate in single series on the first, second, fourth, and sixth; in double on the third, fifth, and seventh, the granules both here and on prothorax strongly umbilicated. Fifth abdominal segment widely excavate, excavation not quite reaching the anterior margin, but coming close to the sides anteriorly, rather shallow at the sides but deep in the middle, preanal fossa being not sharply marked off; fascicles moderately far apart(2 mm.), situated on anterior margin of excavation; posterior border strongly bearded with a fringe of black bristles, an intermediate row of red bristles situated midway between the posterior row of bristles and the anterior margin; forceps short, very stout at base, laminæ obliquely set on inner surfaces of the blades, their apices almost meeting. Dimensions: ♂, 17 × 7 mm.

Hab.—Clarence River(Macleay Museum)—Queensland: Killarney(R. Illidge). Type in Macleay Museum.

Closely allied to *P. variolosa*, but differing in the anal excavation. There is a species from Walcha, N.S.W., in my collection, which may be a variety; it differs in having the fascicles rather closer together, the intermediate bristles not so widely separated from the posterior row, and of a black colour.

Psalidura variolosa, n.sp.

♂. Of a short, subparallel form, convex. Prothorax finely granulate; elytra foveo-striate, interstices granulate; fascicles moderately far apart, forceps and laminæ rather small. Black, opaque, rather sparingly clothed with minute greyish scales; mandibles, sides of metasternum, and first and second ventral segments more closely clothed with yellow scales; legs rather densely clothed with white scales interrupted with dark setæ; setæ dark brown; fascicles dark brown, anal hair black.

Head convex, partially concealed, setigero-punctate, median groove present in front. Rostrum short, ridges somewhat flattened, basal impressions well defined, median notch present; deeply excavate in front, emargination deep, sides strongly dilate; mentum not noticeably thickened in middle, sparingly bearded; mandibles with outer portion lipped in front and densely clothed with short yellow scales interspersed with longer darker hairs. Prothorax as wide as long(6 × 6 mm.), widest about middle, evenly narrowed to base and apex; median lobe strongly produced; collar-constriction moderately marked above, median line faintly impressed near base, also a faint impression near lateral basal angle; finely granulate, granules rather smaller in centre, each with a large setigerous puncture. Elytra oblong(12 × 8 mm.), lightly rounded on sides, widest behind middle, strongly declivous; apex mucronate, flange small; base arcuate, shoulders prominent; irregularly striate, striæ very uneven, shallowly foveate; interstices granulate, granules fine, strongly umbilicated, each puncture bearing a stout seta, first interstice in double series at base; second, third, and fifth tending to be double in places, otherwise the granules are arranged in single series; sides irregularly granulate. Metasternum shallowly concave, almost flat. Fifth ventral segment deeply and widely excavate, excavation not quite reaching anterior margin; preanal fossa deep, transverse; intermediate ridges with short black bristles obscured by the longer setæ upon the posterior edge, these latter not extending across the middle line; fascicles small, moderately widely separated(3 mm.). Forceps small, laminæ obliquely placed along inner side of blades, a tuft of hair projecting downwards from apical tergite between the blades.

♀. Of a more elliptical form than ♂; median prothoracic lobe not so strongly produced, collar-constriction fainter; elytra more gradually rounded to apex, which is not mucronate; shoulders prominent, foveo-striate, foveæ shallow, irregular, interstices granulate, with the exception of the fourth and sixth in double series; ventral segments convex, third and fourth longer than in ♂, fifth not excavate. Dimensions: ♂, 19 × 8; ♀, 19 × 8 mm.

Hab.—South Queensland: Darling Downs (Hermann Lau)—New South Wales: Inverell.

Close to *P. Wilcoxi*, but differing in its larger size and coarser granulation, the intermediate bristles in the anal excavation black and obscured by the posterior row, and in these latter not extending across the middle line.

PSALIDURA BREVIFORMIS, n.sp.

♂. Of a short, convex form, strongly declivous. Prothorax finely granulate, elytra foveo-striate, interstices costate; fascicles widely separated; forceps small, laminæ rather small. Black, subnitid, with minute greyish scales barely traceable in foveæ; legs diluted with red, somewhat densely clothed with short grey pubescence and dark setæ; nigro-setose; fascicles reddish-brown.

Head convex, partially concealed, setigero-punctate, marked with a deep linear impression in front. Rostrum short, thick; ridges well defined, basal impressions very deep, median notch present; central area deeply sunken in front, emargination deep;

mentum thickened and coarsely punctate in middle; mandibles with outer portion produced in front to form a prominent lip. Prothorax slightly longer than wide (7 × 6·5 mm.), regularly rounded on sides, median lobe prominently produced; collar-constriction rather feebly marked above, median line traceable only posteriorly; finely granulate, granules rounded, rather strongly setigero-punctate. Elytra (13 × 8·5 mm.) short, widened from shoulders to behind middle, thence subparallel to apex, strongly declivous posteriorly; apex mucronate, base widely emarginate, humeral angles marked but not produced; disc with six longitudinal striæ, striæ foveate, the foveæ rather shallow and irregular but better marked in the lateral striæ; interstices raised, costiform, somewhat wavy in course, setigerous; sutural interstice only costiform at base, second costiform in middle, becoming granular at base and on declivity, third and fifth prominent and costate throughout, fourth and sixth not prominent, represented each by a row of granules, seventh costate; sides irregularly seriate-foveate. Metasternum with a wide median depression, laterally somewhat raised and convex. Fifth ventral segment widely excavate, the excavation wide, deep, short from before backwards, and reaching anterior margin; preanal fossa deep; intermediate ridges well marked, running from posterior border at extreme edge to the side of the fossa, and bearing a row of black hairlike bristles projecting downwards and backwards, posterior edge also clothed laterally with a fringe of longer bristles projecting downwards, and obscuring the intermediate row; fascicles small, and widely separated(3·5 mm.). Forceps rather short, moderately curved, clothed with black setæ; laminæ rather small, downturned, situated obliquely along base of inner surface of blades, so as to be almost hidden from below. Dimensions: ♂, 19 × 8·5 mm.

Hab.—Glen Innes(H. W. Brown).

In its short ampliate form, this species approaches to *P. variolosa* and *P. Wilcoxi.* In its widely excavate fifth ventral segment, strongly hirsute posterior border and intermediate ridge it also closely resembles those two species; from both, however, its costate elytra and black shining colour will distinguish it.

P. DECIPIENS Dohrn; Dohrn, Stett. Ent. Zeit. 1872, p.143.

"Oblongo-elliptica, fusca, in cavitatibus brunneo-squamulosa, thorace rotundato, in medio ampliato, confertim tuberculato, apice nonnihil producto, elytris porcatis, costis tuberculorum nigrorum seriebus, humeris tuberculo majore insignitis, ad suturam mucronatis."

"♂. Elytris apice sensim ampliatis, ventre subtus apice excavato, ano forfice validissima armato."

"Long.corp.(rostro excluso) 12-13 millim. Lat. 4-5 mill. Long. forficis 4-5 mm."

"♀. Elytris ovalibus, versus apicem haud ampliatis, segmento anali inermi."

"Patria: Australia orientalis."

The above is Dohrn's description of the species; the size given prohibits my regarding it as any of the species before me; while in the description there is not sufficient to enable me to assign it to any group. I have placed it near *P. Wilcoxi* merely because that is the smallest species known to me; but the length of the forceps quoted, would indicate a very different species.

PSALIDURA METASTERNALIS, n.sp.

♂. Elongate, subparallel; prothorax minutely granulate, elytra foveo-striate, interstices thickly granulate; fascicles widely separate. Black, opaque; clothed with muddy scales in the depressions; setæ black.

Head convex, somewhat thickly setigero-punctate, punctures extending on to rostral ridges. Rostrum short, thick, flat posteriorly, shallowly excavate at apex; ridges flattened; basal sulci rather feeble, median notch deep, extending anteriorly to form a Y-shaped depression behind marginal plate. Mandibles rounded, slightly produced in front. Prothorax(7·5 × 8 mm.) rotundate, evenly rounded from base to apex, base truncate, apex truncate above, feebly sinuous at sides, no definite median or ocular lobes; collar-constriction faint, median line feeble; disc densely and minutely granulate, the granules contiguous, somewhat flattened, each bearing a decumbent black seta. Elytra (16 × 10 mm.), sides parallel in middle, slightly rounded to shoulders and feebly narrowed in front of apex; humeral angles not produced; foveo-striate, the depressions shallow but separated by distinct cross reticulations, interstices densely granulate, granules presenting an abraded appearance, setæ arising from posterior aspect; sides obsoletely rugulose, with small, rather sparse, setigerous granules. Metasternum widely concave, lateral margins produced into a strong tubercle projecting beyond level of middle coxæ. Apical excavation deep, sides vertical, the preanal fossa not well marked off from rest of excavation; position of fascicles taken by two small tubercles widely separated (3 mm.), situated on the edge of the excavation. Forceps strong, moderately long, rather clumsily shaped; laminæ small, not visible with forceps in position. Anterior and middle tibiæ each bearing small granules on under-surface distal to the middle; middle tibiæ feebly excavate beyond the last granule; posterior tibiæ long, thin, and sinuous. Dimensions: ♂, 24 × 10 mm.

Hab.—Hunter River, N.S.W. Type in Macleay Museum.

A remarkable species not close to any known to me; the form of the metasternum would apparently ally it to *P. abnormis*, but the length of the forceps is entirely at variance with any of the species of that group; the linear laminæ would place it in the group of which *P. forficulata* is the type, but it is a species 'sui generis.' The only specimen known to me is the type in the Macleay Museum, but it is so distinct that I have no hesitation in describing it.

PSALIDURA FALCIFORMIS Macleay, *loc. cit.*, p.213.

♂. Black, nigro-setose. Head convex, rostrum short, the ridges flattened, mentum toothed, bearded; prothorax (6 × 6 mm.) rounded, moderately produced in front, finely granulate; elytra (14 × 8 mm.) evenly rounded, shoulders not prominent, striæ regular, transversely ridged, almost foveate, interstices finely granulate, the second, fourth, and sixth in single series, the first, third, fifth, and seventh in double series; the granules shining, each with a long seta projecting posteriorly; metasternum concave, anteriorly on a level with middle coxæ; ventral excavation deep, the edges almost vertical; preanal fossa obscured from view by the laminæ; abdominal fascicles spread out along the margin of the excavation, roughly collected into two groups on each side, the two inner groups about 1 mm. apart; forceps long, very thin, and sickle-shaped, being turned on themselves near the apex, the laminæ very long, broad, and bent inwards, their apices overlapping for a considerable distance. Dimensions: ♂, 20 × 8·5 mm.

Hab.—New South Wales: Mudgee, Coonabarabran(Macleay Museum). Type in Australian Museum.

A member of the *P.-impressa*-group, it may be distinguished from all its allies by the abdominal fascicles being arranged in four bundles instead of two; the forceps also are longer, more incurved and twisted on themselves than in any other of the group; it is probably most closely allied to *P. Sloanei* and *P. flavovaria.*

Psalidura kosciuskoana, n.sp.

♂. Oblong-elongate, convex. Prothorax finely granulate, elytra striate, interstices thickly and finely granulate; fascicles widely separated; forceps short, concealed; laminæ very long, meeting at apex. Black, opaque, granules shining, legs diluted with red; setæ black; fascicles red.

Head convex, densely setigero-punctate, a single punctiform depression in centre of forehead. Rostrum short, ridges rather flattened, setigero-punctate; basal grooves narrow, rather shallow, median notch present, median area deeply sunken anteriorly, emargination deep. Mentum bearded in centre with a tuft of long black bristles, dentate anteriorly. Mandibles simple, outer portion nigro-setose. Prothorax(7 × 7 mm.) rounded on sides, widest in front of middle, median lobe feebly produced; disc feebly flattened in centre, collar-constriction faint, no median line; finely and densely granulate, granules contiguous, rather denser in centre, each punctate and bearing a long black seta.

Elytra(16 × 8 mm.) elongate, uniformly and gently rounded from base to apex, strongly declivous posteriorly; apex abruptly rounded, obtusely mucronate; base arcuate, shoulders tuberculiform, regularly and deeply striate, striæ transversely ridged, not definitely foveate; interstices regular, narrower than striæ, granulate in double series, becoming triple in some places, granules rounded, shining, nigro-setose; sutural interstice consisting of a single row of granules, and along the inner side of this a double row of much finer granules. Sides irregularly granulate. Metasternum transversely concave, raised anterolaterally in the form of two ridges separated in the centre, and ending abruptly laterally. Fifth ventral segment deeply excavate, excavation reaching to anterior margin; preanal fossa transverse, hidden; posterior edge clothed laterally with short black hair; fascicles widely separated(4 mm.), situated on edge of excavation. Forceps extremely short, concealed by elytra, concave on ventral aspect, from which spring the laminæ, these latter very long, and widely rounded at apex, meeting but not overlapping. Legs moderately long, feebly sinuous, clothed with stout setæ, intermingled with a few paler scales. Dimensions: ♂, 22 × 8 mm.

Hab.—New South Wales: Jindabyne(H. J. Carter).

This species was among the *Amycteridæ* brought back from Mt. Kosciusko, by H. J. Carter. It belongs to the *P.-impressa*-group, but may be distinguished from that and all other members of the group by the widely separated abdominal fascicles. The black colour of the derm, not obscured by scales, and the shiny granules give it a very characteristic appearance.

Psalidura impressa Boisduval.

Psalidura impressa Boisd., Voy. Astrolabe, ii., p.375, t.7, f.10; Macleay, *loc. cit.*, p.208; *P. crenata* Boisd., *loc. cit.*, p.385; *P. Helyi* Macleay, *loc. cit.*, p.213; *P. Howitti* Macleay, *loc. cit.*, p.211; *P. mirabunda* Macleay (nec Gyll.), *loc. cit.*, p.207.

♂. Elongate, subparallel, convex; densely clothed with scales varying in colour from grey and yellow to black, prothorax indistinctly trivittate, elytra maculate, setæ pale yellow. Rostral ridges somewhat flattened, the grooves not deep; mentum dentate anteriorly. Prothorax (7 × 7 mm.) widely rounded on sides, anteriorly produced to a moderate extent; finely and closely granulate. Elytra(15 × 9 mm.) not much wider than prothorax, feebly rounded on sides, humeral angles thickened but not prominent; striæ transversely crenulate, hardly definitely foveate, interstices finely and closely setigero-granulate; the first, third, fifth, and seventh in double, the others in single series (in some specimens all the interstices are granulate in double series). Metasternum concave, anteriorly raised to level of middle coxæ. Anal excavation deep, the sides vertical, preanal fossa deep and hidden; fascicles moderately far apart(2 mm.), situated on the edge of the excavation. Forceps rather short, slender towards apex; laminæ long, straight, broad at base and tapering towards apices, which are rounded and do not overlap. Dimensions: ♂, 22 × 9; ♀, 22 × 9·5 mm.

Hab.—Victoria: Melbourne, Fern Tree Gully—Tasmania.

I have examined the types of *P. crenata*, *P. Helyi*, and *P. Howitti*, as well as the one Macleay doubtfully referred to *P. mirabunda*, and cannot distinguish them from the Tasmanian species, *P. impressa*, which can be confidently identified from the description and figure. The continental specimens differ slightly in being, as a rule, smaller and narrower; but in all other particulars, and in the arrangement of the sexual organs of the male, they are identical.

PSALIDURA MIRABUNDA Gyllenhal.

Gyll., Schönh., Gen. Curc. ii., p.471; Bohemann, Schönh., Gen. Curc. vii. (1), p.52; Boisd., Voy. Astrolabe, ii., p.377; Macleay, *loc. cit.*, p.207.

I am quite unable to identify this species from description, the species being originally described from a female. Bohemann described the male, but his description is so short as to be worthless. The species identified doubtfully by Macleay as *P. mirabunda* is the same as *P. impressa* Boisd.

The following excerpts from the description would seem to indicate a species of the *P.-impressa*-group:—" Oculi subovati." " Thorax latitudine medii non longior, rotundatus; antice leviter bisinuatus, lobo medio parum producto." " Elytra . . . angulo humerali prominulo, tuberculato; . . . . supra convexa, obsolete tranversim rugulosa et adhuc obsoletius striato-punctata, interstitiis alternis elevatioribus, subcostatis, omnibus subtilius seriatim tuberculatis, ..."

The species named by me *P. cultrata*, has been sent out from the Brussels Museum under the name of *P. mirabunda* Gyll. There is, however, no means of knowing how this identification was arrived at, and there are several points about the clothing which are laid stress upon in the description, and which are at variance with *P. cultrata*:—" Thorax . . . tuberculis . . . poro et seta declinata, pallida, instructis." " Elytra . . . . tuberculis poro et seta pallida instructis; nigro-fusca, opaca, in cavitatibus parce cinero-squamulosa."

In *P. cultrata* the setæ are of very dark brown or black colour, while the elytral clothing, though sparingly present in the " cavities," can hardly be called cinereous.

Of the last segment it states—" Segmento ultimo magno, rotundato, medio impresso." This, though there is a faint mesial impression, agrees much more with the female of *P. impressa*, as do also the clothing and setæ.

I have a female which agrees very closely with the description of *P. mirabunda* Gyll., but, as the females of several of this group also do so, I hesitate to describe it more fully.

Psalidura flavovaria, n.sp.

♂. Elliptical-oval, convex. Prothorax finely granulate, elytra striate, interstices granulate; fascicles moderately close; forceps short, laminæ long and overlapping. Black, rather densely clothed with fine scales varying on the elytra from yellow to reddish-brown, elsewhere yellow, undersurface bare except for a few scales, more marked on metasternum and at sides, setæ yellow, long; fascicles red, anal hairs dark brown.

Head convex, clothed with yellow scales intermingled with setæ. Rostrum short, ridges flattened, basal impressions shallow, but with a well marked groove leading from median notch to depression behind the marginal plate. Mentum bearded, dentate anteriorly. Mandibles simple, densely clothed with yellow setæ. Prothorax (6 × 6 mm.) evenly rounded on sides, median lobe slightly produced, collar-constriction feeble, median line traceable throughout; densely and finely granulate, granules contiguous, each bearing a long, stout, decumbent seta. Elytra(14 × 8 mm.) rather feebly and evenly rounded on sides, strongly declivous; apex mucronate, base widely emarginate, shoulders moderately prominent; striate, striæ broad, rather indistinctly divided into foveæ by transverse setigerous ridges, interstices closely granulate in double series except on the fourth and sixth, and ends of the second interstices, where they are in single series; sutural interstices widened at base, and to less extent the third and fifth also, granules fine, umbilicated, setigerous; sides irregularly granulate. Metasternum widely concave, moderately raised at sides. Fifth ventral segment moderately deeply excavate, excavation barely reaching to anterior margin; preanal fossa deep, not very sharply marked off from rest of excavation; posterior border fringed laterally with short hairs, supernumerary ridges present at sides; fascicles small, moderately close(1 mm.), situated just within the edge of the excavation. Forceps short, thin, with the blades turned on themselves near apex; laminæ very long and curved, rather narrow near base, but broadening out to apex, apices widely rounded, overlapping; forceps fringed along inner edge. Postanal process of apical tergite strongly bearded. Legs moderately long, clothed with yellow setæ, and denser black spines on undersurface of tibiæ. Dimensions: ♂, 20 × 8 mm.

Hab.—South Australia(?)(Macleay Museum).

Closely allied to *P. Sloanei*, but differing in its smaller size, finer granulation, and in the colour of the clothing; the abdominal fascicles are also much smaller than in that species, though about the same distance apart. My specimen is from the Macleay Museum, and bears a label "S. Aust.?"; it belongs to a group which is (with the exception of *P. falciformis*) confined to the south-eastern corner of Australia, and may have come from the eastern portion of South Australia.

Psalidura Sloanei, n.sp.

♂. Elongate-oval, convex. Prothorax finely granulate, elytra striate, interstices granulate; fascicles moderately close; forceps short, thin, laminæ broad and overlapping. Black, opaque, densely clothed with scales varying in colour from light grey to yellow and brown; sides of metasternum and ventral segments lightly clothed with yellow pubescence; setæ yellowish-brown; fascicles and hair reddish.

Head strongly convex, densely clothed. Rostrum short, internal ridges more prominent at base than external; basal impressions and median notch strongly marked, behind marginal plate is a deep pit with a groove running along middle from basal notch to pit. Mentum sparingly bearded, and with a median dentiform projection anteriorly. Mandibles simple, clothed with yellow and brown setæ. Prothorax(7 x 8 mm.) evenly rounded on sides, widest about middle, median lobe feebly produced, collar-constriction well marked; disc slightly flattened, median line obsolete; granules fine, discrete, rounded, each with a large setigerous puncture on posterior or lateral aspect. Elytra elongate-ovate(16 x 10 mm.), very little wider than prothorax, evenly rounded from base to apex, base widely emarginate, shoulders prominent, tuberculiform; apex mucronate; striate, striæ somewhat wavy, transversely and feebly rugate; interstices prominent, convex, granulate, granules rounded, setigero-punctate, sutural interstice granulate in double series in basal half only; third, fifth, and seventh in double series; second, fourth, and sixth in single series, becoming double in places; sides longitudinally striate, interstices granulate. Metasternum concave, deeply grooved in middle, raised antero-laterally not quite to level of middle coxæ. Fifth ventral segment deeply excavate, excavation reaching anterior margin only in middle line, preanal fossa deeply sunken, hidden, with a median groove running from fossa to base of segment; posterior edge only visible at sides, supernumerary ridges present at sides; fascicles stout, moderately close(1 mm.), situated just within excavation. Forceps short, blades thin and turned on themselves at apex; laminæ long, rounded at apex and overlapping, fringed at base with short yellow scales extending along forceps. Apical tergite strongly bearded. Legs rather long, densely clothed with pale scales and darker setæ.

♀. Of a shorter, more oval form than ♂; head and prothorax (6·5 × 7 mm.) as in ♂; elytra(14 × 9 mm.) more gradually produced at apex, shoulders not quite so prominent, sculpture as in ♂; ventral segments convex, with a rather faint impressed line running down third, fourth, and fifth segments, expanded in middle of each segment into a shallow depression. Dimensions: ♂, 23 × 10; ♀, 22 × 9 mm.

Hab.—Wagga(Macleay Museum), Mulwala(T. G. Sloane).

Closely allied to *P. impressa*, but differing principally in the laminæ of the forceps being curved and overlapping; the forceps themselves are rather longer and thinner. I have dedicated this species to Mr. T. G. Sloane, who has taken it commonly around Mulwala, and to whom the opportunity of attempting this paper is primarily due.

Psalidura cultrata, n.sp.

♂. Elongate-ovate, rather robust, convex. Prothorax finely granulate; elytra foveo-striate, interstices granulate; fascicles moderately close; forceps short, obtuse, laminæ long and overlapping. Black, opaque; elytral foveæ sparingly clothed with minute muddy scales; setæ black; fascicles and anal hair black.

Head convex, rather densely, rostrum more sparingly, setigero-punctate. Rostrum very short, internal ridges more prominent at base than the external, basal sulci rather shallow but with a well defined median notch, median area depressed, running into pit behind marginal plate. Antennæ with the second joint of funicle noticeably smaller than first. Mentum sparingly bearded, dentate anteriorly. Mandibles simple, clothed with long setæ Prothorax(7 × 8 mm.) evenly rounded on sides, widest about middle; median lobe feebly produced, disc feebly flattened in centre, with faint collar-constriction and well marked median line; granulate, granules fine, larger about collar-constriction and sides of base, closely set and setigerous. Elytra(16 × 9·5 mm.) evenly rounded on sides, strongly declivous; base rather deeply emarginate, shoulders thickened, outturned and prominent; apex mucronate; foveo-striate, foveæ almost quadrilateral, separated by rather low transverse ridges; interstices slightly wavy in course, finely setigero-granulate, sutural interstice only prominent at base; second, fourth, and sixth in single series, somewhat irregular; third, fifth, and seventh in double series; sides longitudinally striate, interstices granulate. Metasternum widely concave, raised laterally almost to level of middle coxæ. Anal excavation moderately deep, extending to anterior margin in the middle line; preanal fossa not very sharply marked off, with a median line or groove extending from fossa to anterior margin; posterior edge with a short fringe of black hair at the sides; fascicles moderately close(1 mm.) and situated well within the excavation. Forceps extremely short and obtuse, not quite meeting at apex; laminæ very long, parallel-sided, apices broadly rounded, overlapping. Penis narrowed towards apex, which is bulbous. Postanal process of apical tergite strongly bearded. Legs moderately long, clothed with black setæ and rather stout spines along undersurface of tibiæ.

♀. Somewhat smaller and more elliptical in shape, apex not so abruptly rounded; head and prothorax(6 × 7·5 mm.) as in ♂; the median line, however, is not present; elytra(14 × 9 mm.) with the foveæ not quite so distinct; ventral segments larger, feebly convex, with shallow lateral impressions, and a median impression on the apical segment. Dimensions: ♂, 23 × 9·5; ♀, 21 × 9 mm.

Hab.—"Australia"(Brussels Museum); Victoria, Melbourne.

This species has been sent to Mr. A. M. Lea from the Brussels Museum under the name of *P. mirabunda* Gyll.; but, for reasons cited under that species, I am inclined to maintain it as distinct. From *P. impressa*, it differs, *inter alia*, in the blunter and stouter forceps. It is more closely allied to *P. monticola*, which may later be shown to be entitled only to varietal rank. I am indebted to Mr. A. M. Lea for my specimens.

PSALIDURA MONTICOLA, n.sp.

♂. Of an elongate, subparallel, form, convex. Prothorax finely granulate; elytra foveo-striate, interstices granulate; fascicles moderately close; forceps short, laminæ very long, not overlapping. Black, opaque, sparingly clothed with minute muddy scales; setæ dark brown, fascicles red.

Head convex, rather closely setigero-punctate. Rostrum short, external ridges somewhat flattened, internal ridges prominent, separated at base; basal impressions well defined, median area depressed in front into a deep pit behind emargination. Mentum sparingly bearded, anteriorly dentate. Mandibles simple, clothed with long setæ. Prothorax($6 \times 6{\cdot}5$ mm.) rounded on sides, feebly produced in front, disc somewhat flattened, collar-constriction faint, median line traceable throughout; closely and finely granulate, granules setigero-punctate, rounded, smaller and closer together in centre than at sides. Elytra(14×8 mm.) subparallel, widest beyond middle, and feebly rounded to base and apex; apex abruptly rounded, mucronate; base widely arcuate, shoulders not prominent; foveo-striate, foveæ transverse, rather irregular; interstices granulate, granules fine, setigero-punctate, arranged for the most part in double series, the fourth and sixth in parts in single series, sutural interstice flattened and thickened at base, elsewhere represented by a row of minute granules; sides granulate. Metasternum declivous posteriorly, widely concave, sides raised almost to level of middle coxæ. Anal excavation deep, reaching to anterior margin; preanal fossa hidden, posterior edge fringed at extreme sides; fascicles moderately separated (about the same distance apart as in *P. impressa*), rather small, situated just within border of declivity. Forceps very short, barely meeting at apex and not projecting beyond elytra; laminæ very long, apices widely rounded, meeting but not overlapping. Penis narrow, apex truncated, feebly notched. Legs moderately long, tibiæ with grey scales and strong black setæ or spines along under side.

♀. Of a more oval form, apex more gradually produced. Head and prothorax(5 × 6 mm.) as in ♂, but prothoracic impressions absent; elytra(14 × 9 mm.) more rounded on sides, apex not mucronate, shoulders slightly more prominent, sculpture less regular; undersurface slightly convex, fifth ventral segment with a well defined median impression not reaching base or apex. Dimensions: ♂, 20 × 8 mm.; ♀, 20 × 9 mm.

Hab.—Victoria: Buffalo Mountains(T. G. Sloane); Mt. Macedon.

Close to the preceding species, and to *P. impressa*; the form of the laminæ will at once distinguish it from the latter. From *P. cultrata* it differs in its more parallel-sided form, and somewhat differently sculptured elytra; the depressions in the elytral striæ are smaller and much more irregular, while the intrastrial granules are more prominent; the forceps are as in *P. cultrata*, but the laminæ merely meet at the apex and do not overlap; the penis is also differently shaped; the abdominal fascicles are slightly further apart, and somewhat differently set.

Psalidura abnormis Macleay, *loc. cit.*, p.215.

♂. A small parallel-sided species, without evident forceps. Black, legs red; sparingly clothed with muddy-brown scales, negro-setose.

Head convex, rostral ridges flattened, sulci obsolete at base, median area strongly depressed; mentum bearded, dentate anteriorly. Prothorax(6·5 × 6·5 mm.) rotundate, apex slightly produced, feebly depressed along median line; very finely and closely granulate. Elytra almost parallel-sided, scarcely wider than prothorax (13 × 7 mm.); base arcuate, shoulders tuberculiform; striæ transversely ridged, almost foveate, interstices not much narrower than striæ, finely granulate in double series throughout except on declivity, where they are in single series, but closely placed and not larger than on the rest of the interstice. Metasternum concave, the lateral borders raised in the form of a distinct tubercle to the level of the middle coxæ. Apical segment deeply excavate, the excavation reaching anterior margin for a considerable distance on either side of the middle line; fossa deep, transverse, running out towards each postero-lateral angle;

fascicles small, situated far apart, almost at extreme margin of segment; forceps hidden except the apices, which are rounded, convex externally and concave internally, not meeting; laminæ very small, projecting slightly beyond apex of forceps. Apical tergite visible between blades. Dimensions: ♂, 19 × 7; ♀, 18 × 7·5 mm.

Hab.—New South Wales: Goulburn, Yass, Gunning, Shoalhaven.

The identity of this species is unfortunately somewhat open to dispute, as I cannot say with certainty that the type has been examined. Under the label of *P. abnormis*, in the Macleay Museum, there is only a female, while the pair in the Australian Museum bear the locality Monaro. Macleay, in his paper, described *P. abnormis* as from Argyle, and the species described above is from that locality; furthermore, I have found, among the Macleay duplicates, a specimen bearing the name *P. abnormis* in Macleay's handwriting. This species extends along the southern highlands, but in Monaro its place is taken by two other forms, both at present undescribed; one is the pair above mentioned, in the Australian Museum; and the other has been thought to be *P. d'Urvillei*; pending investigation into the identity of the latter, I have described neither as new.

P. abnormis is replaced, further to the west, by *P. assimilis.*

Psalidura assimilis, n.sp.

♂. Elongate, subparallel, convex. Prothorax finely granulate; elytra striate, interstices rather coarsely granulate; anal excavation deep; forceps hidden. Black, granules shining, legs reddish-brown, sparingly clothed with minute black scales between the granules; legs clothed with stout black setæ intermingled with light yellow scales; abdomen with a few sparse yellow scales; nigro-setose.

Head convex, strongly somewhat rugosely punctured. Rostrum fully excavate, ridges flattened, lateral basal sulci almost obliterated; median basal notch very deep, leading across median area into a Λ-shaped sulcus behind marginal plate. Mandibles simple, slightly lipped. Mentum bearded, anteriorly dentate. Prothorax(7 × 6·5 mm.), feebly dilated on sides, widest in front of middle, base truncate, apex slightly produced in middle; median impression and collar-constriction rather faintly marked; disc finely, closely, and evenly granulate, the granules becoming larger on the sides. Elytra(14 × 8 mm.) very little wider than prothorax, gently rounded on the sides, apex not mucronate, base emarginate, shoulders prominent, tuberculiform; disc regularly striate, striæ slightly wavy in course, and crossed by numerous low rugæ, interstices regularly setigero-granulate, sutural granules much finer than the others, in double series only at base; second interstice in double, the others in single series; all the interstices stopping short at the apical declivity; the third, fifth and seventh each being represented on the declivity by two or three isolated slightly larger granules. Metasternum concave, lateral margins raised to level of middle coxæ. Anal excavation deep, extending to anterior margin of the segment for a considerable distance on either side of the middle line; preanal fossa deep, transverse; posterior border without any sinuosity; fascicles situated far apart, near the posterior margin of the excavation. Forceps hidden except the apices, these widely separated, obtusely pointed, the laminæ being very small, and situated on the inner surface, slightly projecting beyond tips of forceps. Penis truncate, apex notched. Legs moderately long, tibiæ feebly sinuous.

♀. Of a slightly more ovoid form than ♂, elytra more narrowed posteriorly, this difference not being so marked as in *P. abnormis* or other species of the genus; in the head, prothorax(6·5 × 7 mm.), and elytral sculpture (14 × 9 mm.), it resembles the male; ventrally it differs in being slightly convex, in wanting the lateral tubercles on the metasternum, in having the intermediate segments longer, and in the apical segment not being excavate, but with a faint impressed line posteriorly. Dimensions: ♂, 21 × 8; ♀, 21 × 9 mm.

Hab.—New South Wales: Hartley (E. W. Ferguson), Orange (T. G. Sloane).

Very close to *P. abnormis* Macleay, but differing in its larger size, different clothing, darker setæ, and in elytral sculpture. The elytral granules in *P. assimilis* are rather coarser, in single series (except on the third interstice), and with only the alternate interstices represented (by two or three granules each) on the declivity; the humeral angles are also more prominent.

PSALIDURA PERLATA, n.sp.

♂. Of a short, ampliate form, convex. Prothorax finely granulate; elytra striate, interstices granulate, apical excavation shallow, no fascicles present; forceps hidden, apices not meeting. Black, legs reddish; densely clothed with grey and yellow scales, giving elytra a maculate appearance; apical tergite clothed with yellow hair; legs with yellow setæ and short white scales intermingled; setæ yellow.

Head wide, convex, rather sparingly setigero-punctate. Rostrum well marked off from head, external ridges wide, feebly convex, internal ridges depressed, lateral sulci and median basal notch represented by three small isolated impressions along transverse sulcus; median area narrow, depressed in front behind marginal plate. Mandibles simple, the outer portion thickly covered with stout yellow setæ. Mentum sparsely bearded, dentate anteriorly. Prothorax(6 x 7 mm.) roundly dilated, widest in front of middle, apical lobe feebly produced, no collar-constriction nor median line. Closely covered with round, black, shining discrete granules, closer together and finer in the centre. Elytra (13 x 8 mm.) evenly rounded on sides, very wide; apex strongly flanged, not mucronate; base feeble excavate, humeral angles marked but not prominent; disc with rather shallow longitudinal striæ, the sculpture of which is obscured by the thick clothing but not foveate; interstices rather broad, irregularly granulate in double series, the granules unequal in size, the larger ones slightly flattened, shining, each bearing a long decumbent yellow seta. Sides somewhat irregularly granulate, rather more coarsely than on disc. Metasternum transversely concave, the lateral margins raised on each side in the form of a prominent tubercle beyond the level of the middle coxæ. Third and fourth ventral segments short, depressed along anterior margin; fifth shallowly excavate, the limits of the excavation not well defined but extending to the anterior margin of the segment for some distance on either side of the middle line; preanal fossa in the form of a parallel-sided sulcus, deepest in the middle, running the whole length of the posterior border, and separated from the excavation by a definite ridge; no fascicles present. Forceps hidden except the apices, which are rounded and with short fringe of bristles on the inner surface. Penis blunt, almost truncate. Legs moderately long; anterior tibiæ with the lower end bent sharply inwards, almost at right angles. Dimensions: ♂, 19 × 8 mm.

Hab.—South Australia, Eucla—West Australia, Eyre (C. French).

A remarkable species lying on the border line between *Psali dura* and *Talaurinus*. In general appearance close to *T Riverinæ* Macl., but more nearly allied to *P. abnormis* Macl., in the form of the metasternum, and in the forceps. The form of the anal excavation, however, is very similar to that in *T. Riverinæ*, and that species may have to remain, where Lea* has placed it, in *Psalidura*. On dissecting the specimen before me, as far as possible, the existence of a vertical plate between the ends of the forceps was disclosed.

Postscript (*added November 29th, 1909*).—While the foregoing paper has been passing through the press, I have been able to obtain a translation of the second part of Dohrn's paper, which throws light on some of the more obscure species. I should like, therefore, to add the following notes:—

P. decipiens Dohrn.—This species should, from Dohrn's description, be a member of the *P.-forficulata*-group. It has the abdominal fascicles close together (1 mm.), but may be distinguished by its smaller size (12-13 mm.) and apparently coarser elytral sculpture.

P. mirabilis Kirby.—Dohrn has shown that the species hitherto regarded as *P. mirabilis* can no longer be so; and he has named

* Trans. Roy. Soc. South Australia, xxviii., 1904. p. 111.

it *P. Gyllenhali.* As, however, *P. reticulata* Boisd., was founded on the female example of the same species, that name must take precedence. At present, I am ignorant of the true identity of *P. mirabilis* Kirby.

P. mirabunda Gyll.—Dohrn had before him three specimens, which he designated as Nos. 5, 6, and 7. No.5, ♂, bears a label: "*Phalid impressa*, Dupont. N. Holl. Dupont"; and, while in a bad condition, bears evidence of dense elytral clothing. No.6, ♂, bears two labels: "Tasmania" and "Mus. Gall." No.7, ♀, is Gyllenhal's type.

Dohrn, after considerable discussion of the question, came to the conclusion that No.5 = *P. impressa* Boisd., Nos.6 and 7 = *P. mirabunda*; and he states that possibly, through long life and abrasion, the one might be reduced to the condition of the other. This is my own opinion, and I have little hesitation in stating that *P. mirabunda* Gyll., = *P. impressa* Boisd.

NOTES FROM THE BOTANIC GARDENS. No.15. ON A PLANT, IN FRUIT, DOUBTFULLY REFERRED TO *CYMODOCEA*.

By J. H. Maiden and E. Betche.

(Plate xlix.)

POTAMOGETONACEÆ.

Cymodocea(?) ciliata (Forsk.) Ehrenb.

Murray Island, Torres Straits; (Charles Hedley, September, 1907; and specially brought under our notice by Mr. A. H. S. Lucas).

The fruit and floral organs of this species have never been previously obtained, and a description of the mature fruit will be therefore of interest.

Fruit-carpel solitary, on a thick stalk nearly 20 mm. long, ovate-globular, compressed, about 17 mm. long and slightly less broad, crowned by the thick persistent base of the style, of soft coriaceous texture and densely covered with short soft prickles thickened at the base. At full maturity the carpel opens at the top in more or less deep slits, forming irregular teeth or lobes, from a few to 8 or 9 in number. Seeds 1 to 3 in the carpel, attached laterally, roughly globular, but of irregular shape and somewhat umbonate, about 10 mm. in diameter; testa thin; embryo slightly curved.

Ascherson and Gräbner describe the fruits of Potamogetonaceæ in "Das Pflanzenreich" (1907) in the following words: "Fructus drupacei vel pericarpio membranaceo, maturi non dehiscentes, monospermi."

From the above description, and from our description and figure of the fruits of *Cymodocea ciliata*, it will be seen that the position of this species is abnormal, not only in the genus *Cymodocea*, but also in the Family *Potamogetonaceæ*; the plurality of seeds being without precedent in the Family. We found three seeds in one of the old open fruits, two seeds in another one, and one seed in an unopened fruit which we figure in longitudinal section(fig.G). The question now arises, should the species be removed from the genus, in spite of the great similarity of the vegetative organs to other species of *Cymodocea* whose floral organs are known? We think it would be premature to propose such a change in the present state of our knowledge of the plant; for both male and female flowers are still unknown, and it would be difficult to give its right position in the system without knowledge of the flowers.

There is a note on *C. zosterifolia* F.v.M., by the late Baron von Mueller, in the Victorian Naturalist for February, 1893, but the species to which we refer is not touched upon.

We are indebted to Mr. C. Hedley, F.L.S., for the following note upon his specimens—" I gathered the accompanying plants during the last week in September, 1907, on a mud-flat, at low water, on the western shore of Mer, the largest of the Murray Islands. Haddon* has recorded and figured the Murray Cymadocea as the food of the dugong. Observing this, I asked a native to point out to me the dugongi food—in pigeon English, 'You go catch'em proper kaikai belonga dugong.' He took me to a mud-flat just uncovered at low-water of neap tide, thickly grassed with Zostera. Hidden among the Zostera and evidently close cropped by the dugong, was the Cymodocea. The flowering-season had not long passed, but I was able to secure the fruits which you have examined."

EXPLANATION OF PLATE XLIX.

Cymodocea(?) *ciliata* (Forsk.) Ehrenb.

Fig. A.—Plant in fruit.
Fig. B.—Top of a leaf, magnified.
Fig. C.—Portion of a leaf still more magnified.
Fig. D.—Fruit-carpel.
Fig. E.—Fruit-carpel opened.
Fig. F.—Fruit-carpel showing two seeds.
Fig. G.—Vertical section of fruit-carpel.
Fig. H.—Soft prickles covering the carpel, magnified.
Fig. I.—Seed.
Fig. K.—Vertical section of seed.

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* Haddon, "Head-Hunters, Black, White and Brown," 1901, pp.151-2, fig. 16.

WEDNESDAY, OCTOBER 27TH, 1909.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, October 27th, 1909.

Mr. C. Hedley, F.L.S., President, in the Chair.

ANNOUNCEMENTS.

(1) A Special General Meeting will be held on Wednesday, November 24th, at 8 o'clock, before the Ordinary Monthly Meeting on the same date. *Business:* (1) the confirmation of the amendment of Rules xvi., xxi., and xxiii.(detailed in the Abstract for September); and (2) the election of an Auditor, for which position, Mr. F. H. Rayment, F.C.P.A., will be nominated, on the Council's recommendation.

(2) Professor David's lecture to the Society on the Scientific Results of the British Antarctic Expedition, 1907-09, will be delivered in the Geological Lecture Theatre, at the University, on Wednesday, November 10th, 1909, at 8 p.m. Tickets of admissión will be sent to Members with the Abstract.

(3) The Council is prepared to receive applications for three Linnean Macleay Fellowships, tenable for one year from April 1st, 1910, from qualified Candidates. Applications should be in the hands of the Secretary on or before 30th November, 1909, who will afford all necessary information to intending Candidates.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 10 Vols., 74 Parts or Nos., 20 Bulletins, 1 Report and 14 Pamphlets, received from 46 Societies, &c., and one private donor, were laid upon the table.

NOTES AND EXHIBITS.

Mr. W. J. Rainbow exhibited a small collection of Arachnida obtained by Count Mörner and Mr. W. W. Froggatt in the Solomon Islands, including *Palystes speciosus* Pock., *Gasteracantha signifer* Pock., *G. scintillans* Butl., from Russell Island, a variety of the latter from Guadalcanar Island, and *G. metallica* Pock., from Bougainville Island. The Arachnida of the Archipelago are not well known. The most important paper dealing with this branch of the fauna was published by Pocock ("Scorpions, Pedipalpi, and Spiders from the Solomon Islands," Ann. Mag. Nat. Hist. i. (7), June, 1898, p.457). The Solomon Island Archipelago is the habitat of the most brilliantly coloured Gasteracanthids known.

Mr. A. F. Basset Hull exhibited a skin and an egg of the White-faced Storm-Petrel (*Pelagodroma marina* Latham), and eggs of the Little Penguin (*Eudyptula minor* Gould), taken by him on Tom Thumb Island (Five Islands Group) near Wollongong, N.S.W., on 17th October, 1909. The island, barely half an acre in extent, was inhabited by a colony of about one hundred Storm-Petrels, breeding in burrows in the sand a few inches beneath the roots of *Mesembryanthemum* sp. The burrows were from 2-4 feet in length, with small semicircular entrances. On the south-eastern side, where the first arrivals had made their homes, the burrows contained partly incubated eggs; on the middle of the island the eggs were fresh, while on the north-western side the latest arrivals were sitting in their completed burrows, preparatory to laying. The eggs were laid on the bare sand, or on a few sprigs of salt-bush (*Atriplex* sp.). The bird exhibited was a male, and was taken while sitting on an egg. The Penguins were found in crevices of the rocks beyond reach of the breakers, or in shallow burrows amongst the vegetation at the top of the island. Their nests contained in most instances heavily incubated eggs or young birds in all stages of growth. Hitherto the Storm-Petrel has not been recorded as breeding on the coast of New South Wales, Mud Island, Port Phillip, being the most northerly limit on record. The Penguins are known to breed on Montague Island, and the Tollgates, off Bateman's Bay, and this adds another, more northerly record of the breeding-place of this species. *Puffinus chlororhynchus* Lesson, and *Demiegretta sacra* Gmelin, were also observed preparing their nests on Tom Thumb Island.

Mr. C. F. Laseron, by permission of the Curator, Technological Museum, exhibited a remarkable specimen of *Conularia lævigata* Morris[Mollusca] which was lately forwarded to the Museum by Mr. H. Melville, School-teacher at Lochinvar near Maitland, N.S.W., who obtained it from that district. Very little is known of the aperture in this genus, so that the specimen, which has this structure very well preserved, is of considerable scientific value. In this case the four walls of the shell are bent sharply inwards into the aperture; a fortunate fracture having revealed that they continue downwards into the shell, with a gradual convergence for at least $\frac{3}{5}$ of an inch, the cavity below this point being filled with matrix. The ornamentation is also continued without interruption on the infolded portions of the sides.

Mr. T. H. Johnston exhibited a series of Entozoa collected in New South Wales. The following species were represented :— *Hymenolepis* sp.(immature), from the intestine of a duck(Bathurst); *H. carioca* Magaelh., *Davainea cesticillus* Molin, and *D. tetragona* Molin, from the intestine of fowls (Sydney, Bathurst); *Echinorhynchus* sp., from the rectum of the black snake, *Pseudechys porphyriacus* Shaw,(Gosford, Sydney); *Physaloptera* sp., from the stomach and duodenum of the tiger-snake, *Notechis scutatus*(Sydney); *Œsophagostomum* sp., a very small reddish species which sometimes occurs in hundreds in the upper part of the duodenum of *Mus decumanus* Pall.,(Sydney); *Hymenolepis murina* Duj., *Gigantorhynchus moniliformis* Bremser, and *Trichocephalus nodosus* Rud., from the intestine of *M. alexandrinus* Geoffr., (Sydney);

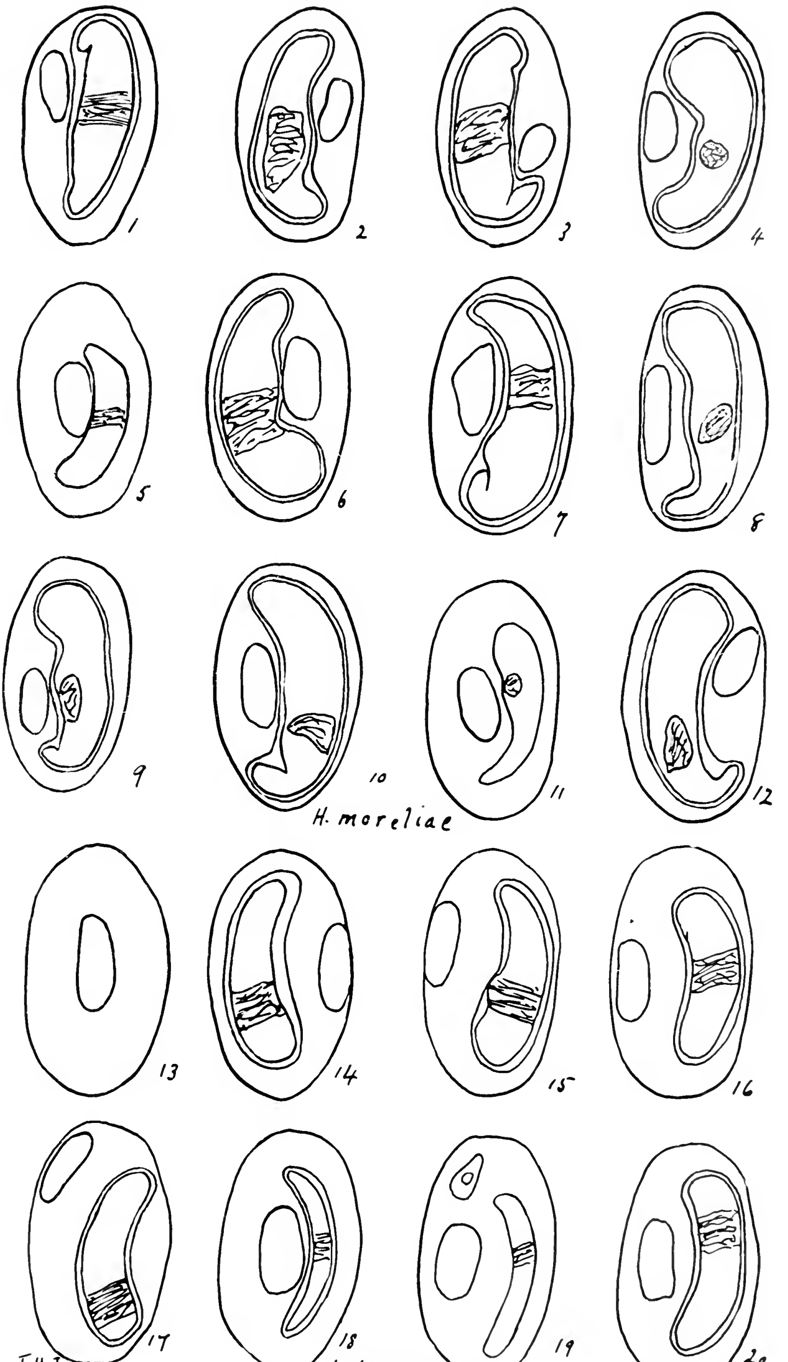
Trichodes crassicauda Bellingham, from the bladder of *M. rattus* Linn., *M. alexandrinus* Geoffr., and *M. musculus* Linn. (Sydney), this parasite being apparently unrecorded from these three hosts in other parts of the world, though it is fairly common in the bladder of *M. decumanus* in this State.

Mr. Baker exhibited (1) dyed specimens of South Australian Sea Balls, compacted fibres of *Posidonia australis.* (2)Timber of *Eucalyptus globulus*, showing unusually wide annual rings, from Barren Jack, N.S.W. And (3) branchlets of a "Grey Gum"(*Eucalyptus punctata*) with variegated leaves, from Point Clare near Gosford, together with sections of such leaves shown under the microscope. The exhibit formed the most remarkable instance of etiolation in a Eucalypt that he had ever seen. The oil-glands of the variegated leaves appeared to be quite normal.

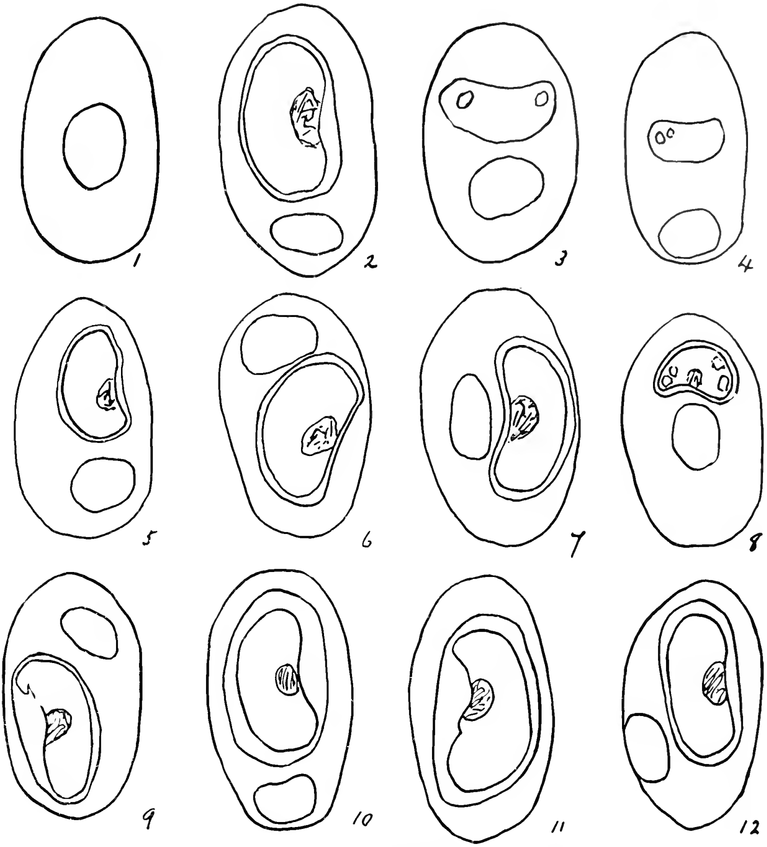
Mr. Cheel exhibited specimens of the Hygrometric Club-moss (*Selaginella lepidophylla*) which is being offered for sale in Sydney just now, together with a locally published circular extolling its virtues, real or imaginary. He also showed examples of two Australian lichens, *Parmeliopsis semiviridis* Nyl., and *Heterodea Muelleri* Nyl., which possess the character of inrolling during dry weather, and unfolding in damp or rainy periods, in a very marked degree, and which displayed it more rapidly even than the Syrian "Rose of Jericho"(*Anastatica Hierochuntica*), or the Mexican *Selaginella lepidophylla* Spring. He showed also fresh specimens of Barley(*Hordeum vulgare* Linn.) raised from seed obtained at the last Agricultural Show, affected with Powdery Mildew(*Erysiphe graminis* DC., syn. *Erysiphe graminis* Link), and a Smut [*Ustilago nuda* (Jen.) Kell. & Sw.], as well as the uredospore stage of a Rust(*Puccinia* sp.). Also Potato-leaves affected with Early Blight of Potatoes(*Macrosporium solani* Ell. & Mart.) and others smitten with the Late Blight or so-called Irish Blight (*Phytophthora infestans* De Bary), obtained respectively from Penshurst and Kogarah.

Dr. Greig-Smith exhibited cultures of two races of a bacterium distantly related to the colon bacillus. These were identical in every respect, excepting with regard to the growth on gelatine, upon which one of them grows as a flat, the other as a slightly raised film. Neither individually ferments saccharose, but a mixed culture is capable of doing so. He also showed two household sponges, one of which had been infected with a slime-forming bacterium originally obtained from a slimy sponge. The infected sponge was very slimy, and had considerably contracted and lost its elastic character. The control-sponge kept under the same conditions was normal.

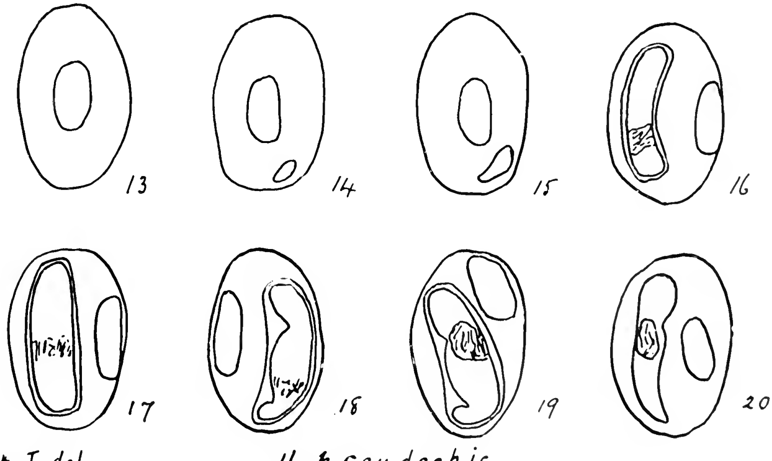
[Printed off December 1st, 1909.]



HÆMOGREGARINES FROM REPTILES



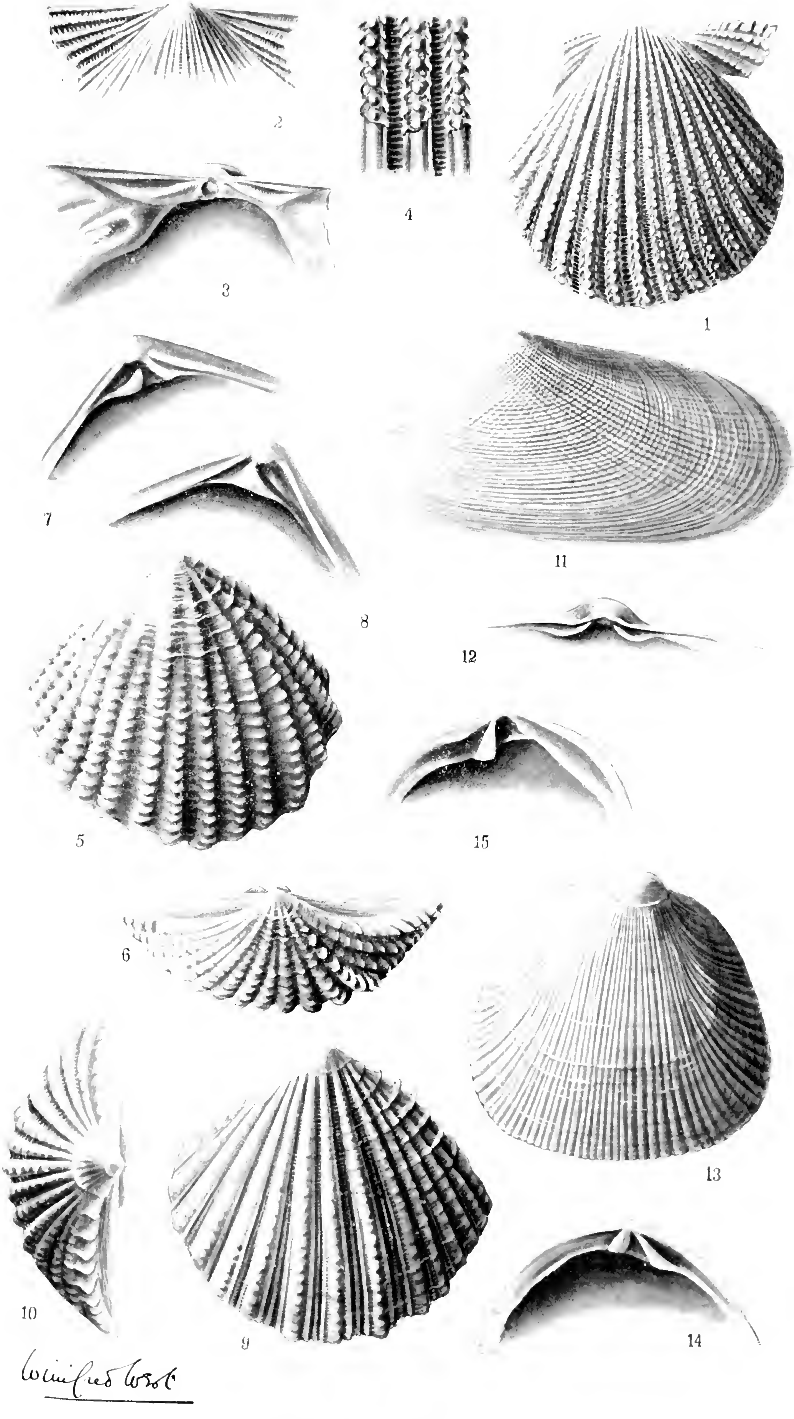
Haemogregarina clelandi



T. A. J. del

H. pseudechis

HÆMOGREGARINES FROM REPTILES.



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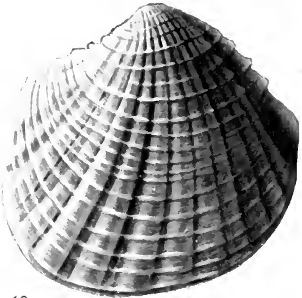

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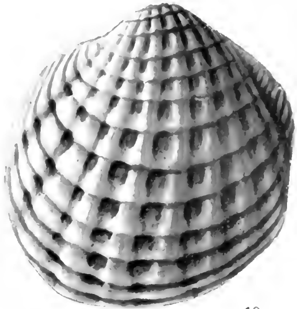

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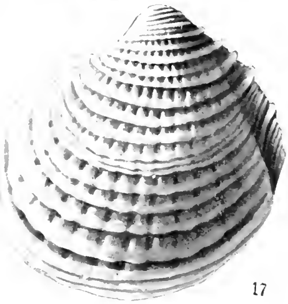

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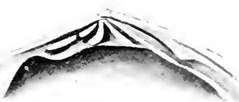

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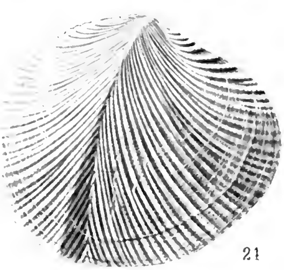

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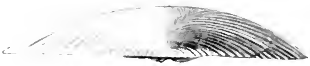

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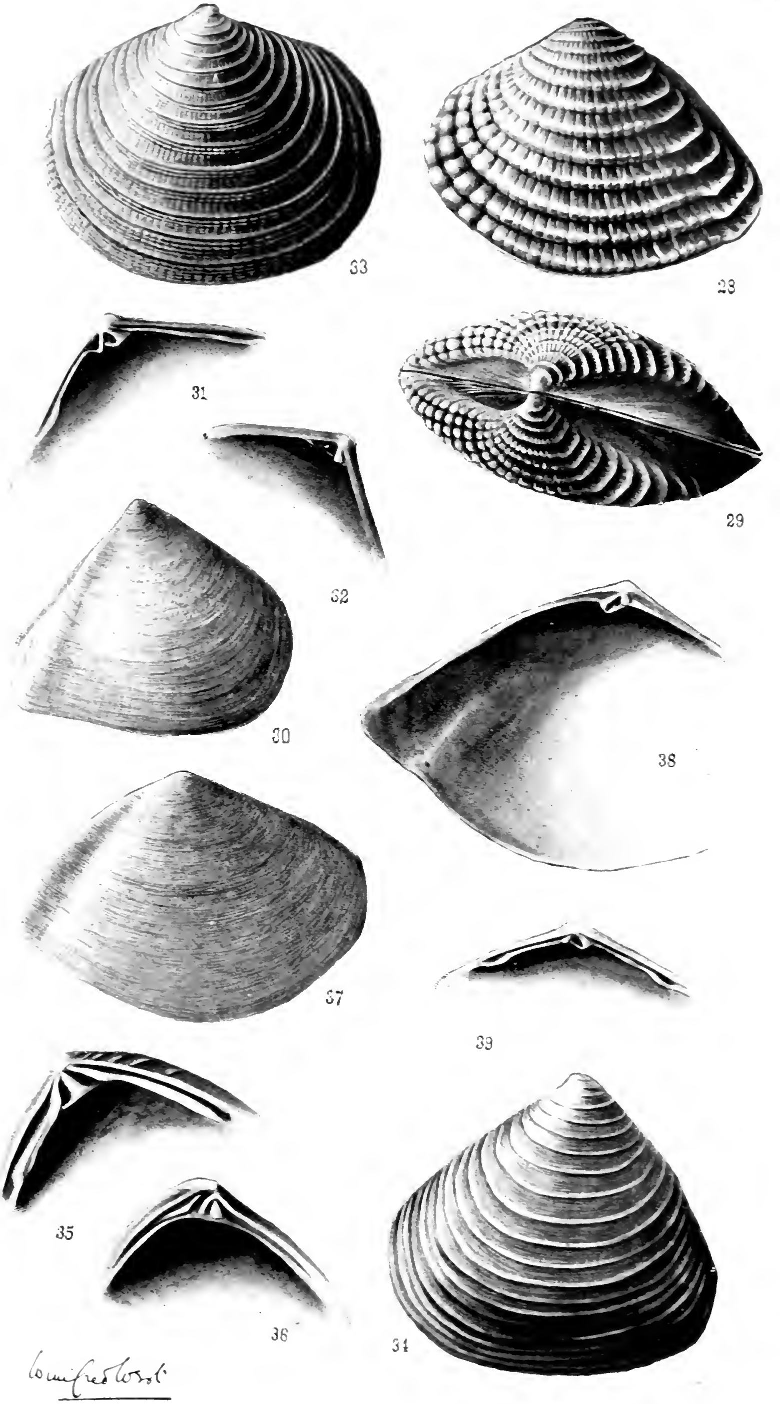

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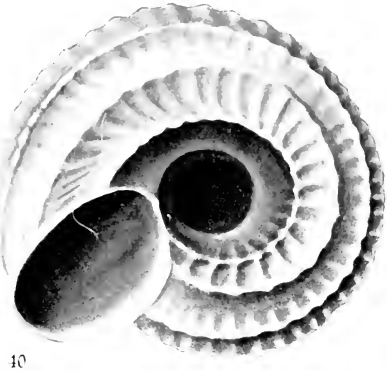

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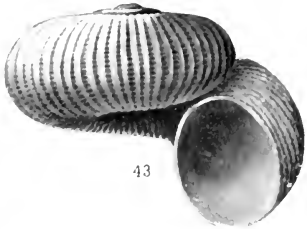

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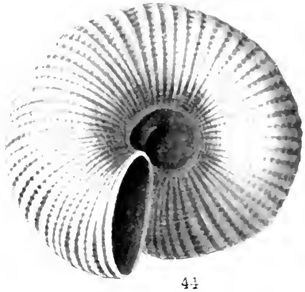

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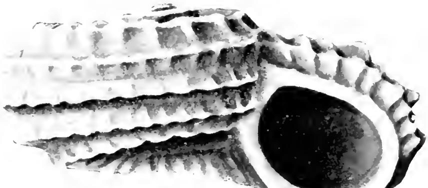

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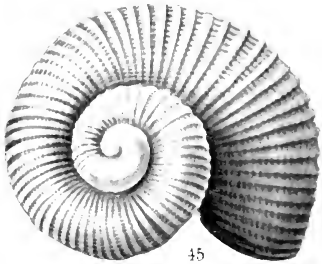

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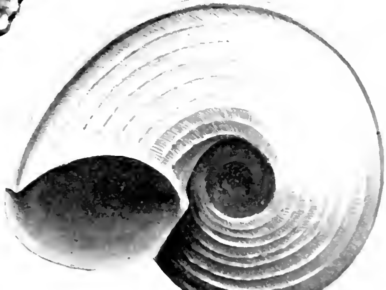

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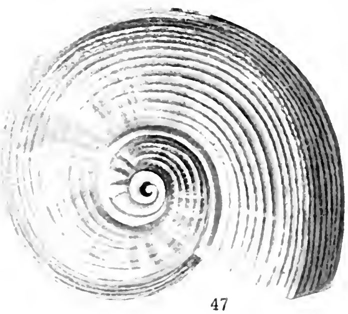

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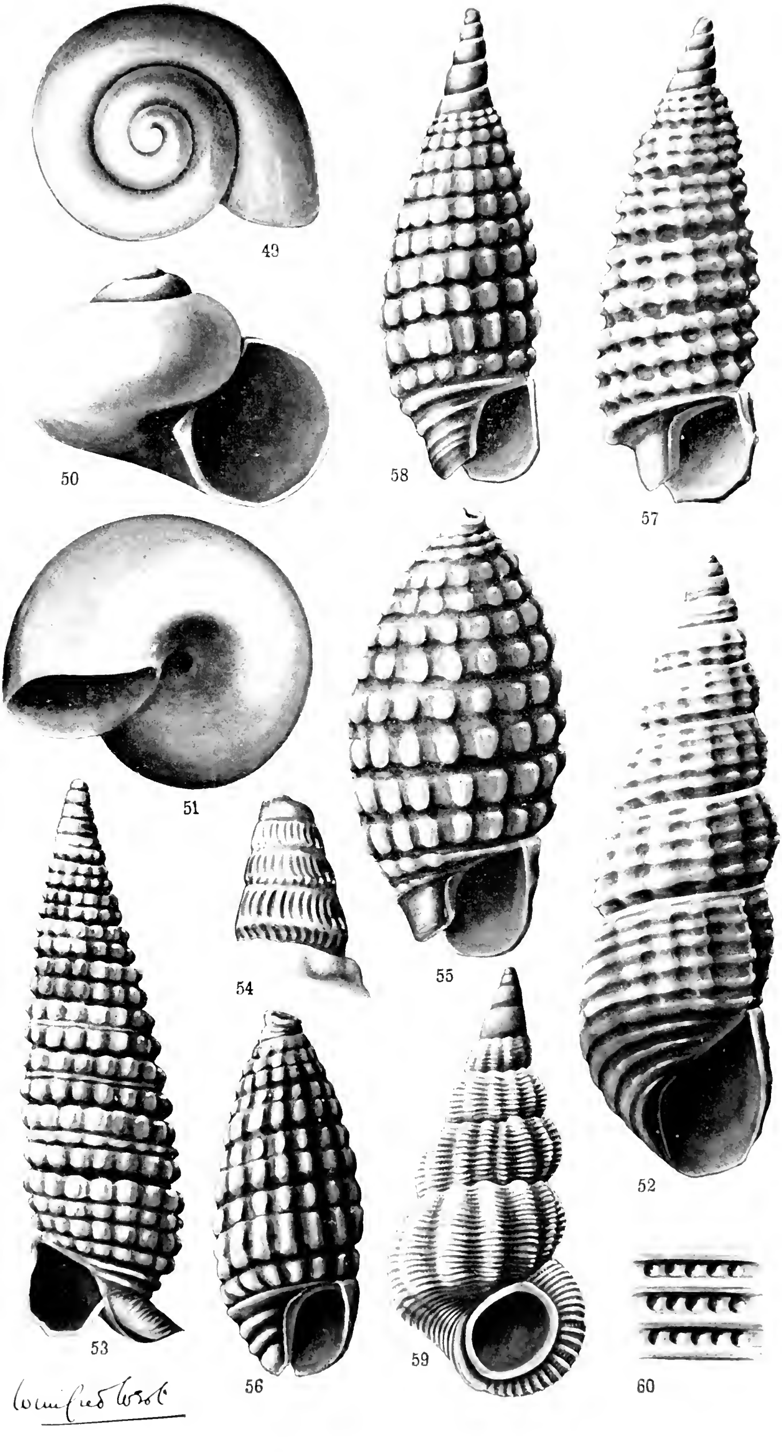

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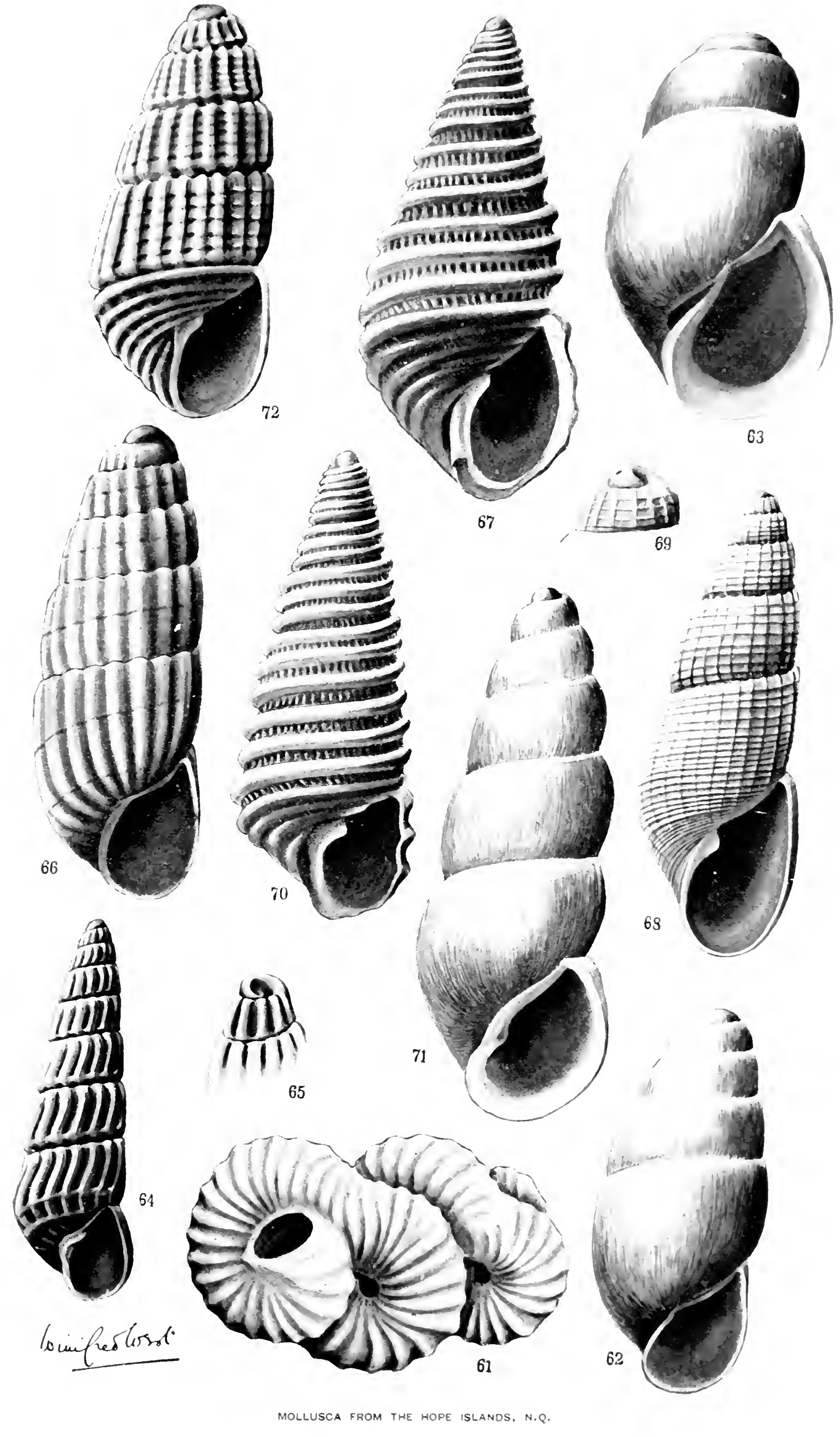

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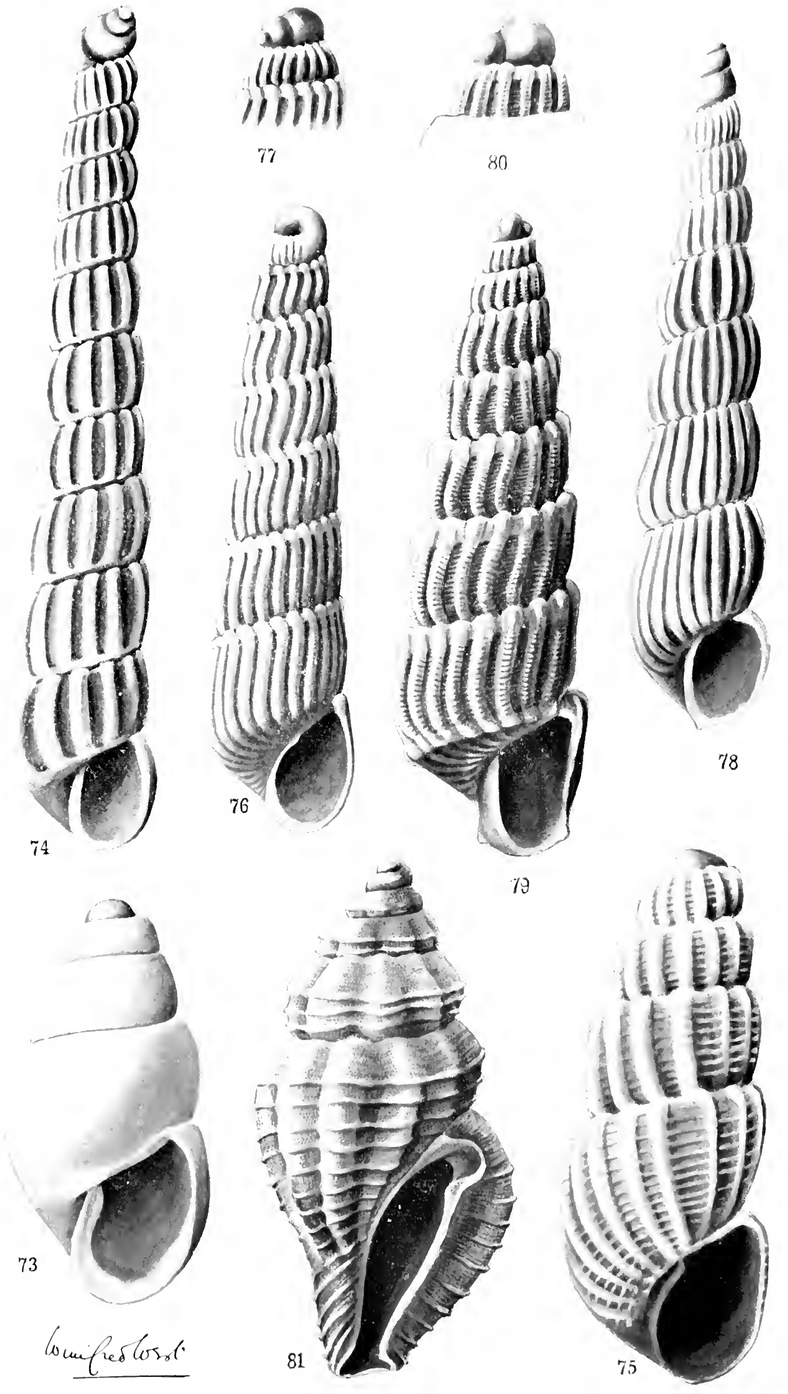

MOLLUSCA FROM THE HOPE ISLANDS, N.Q.


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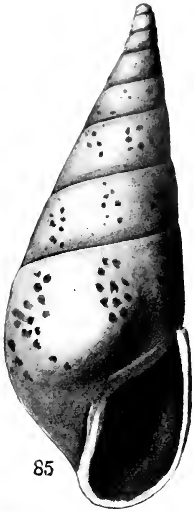
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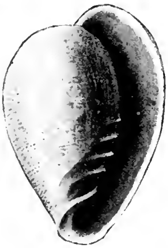
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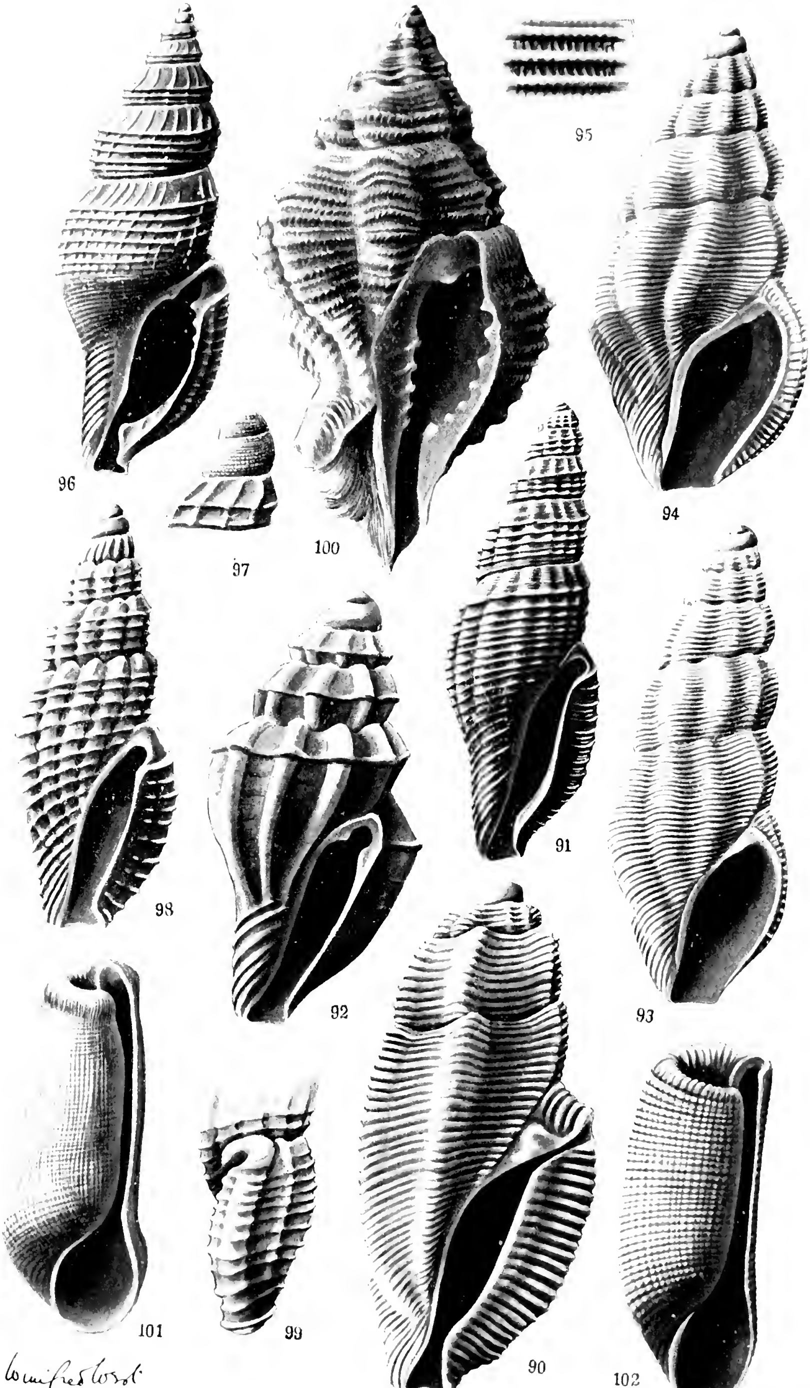

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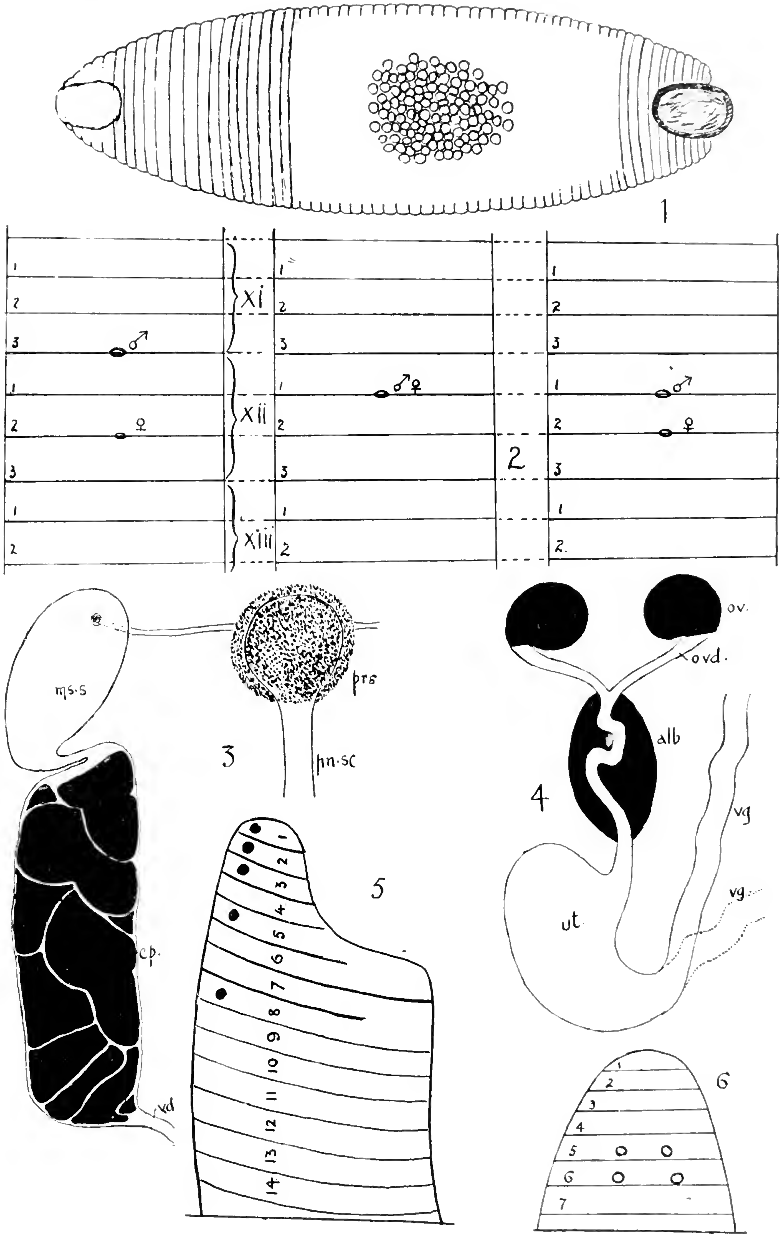
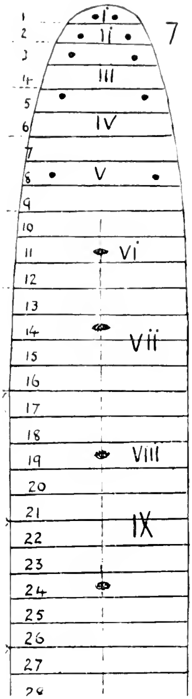
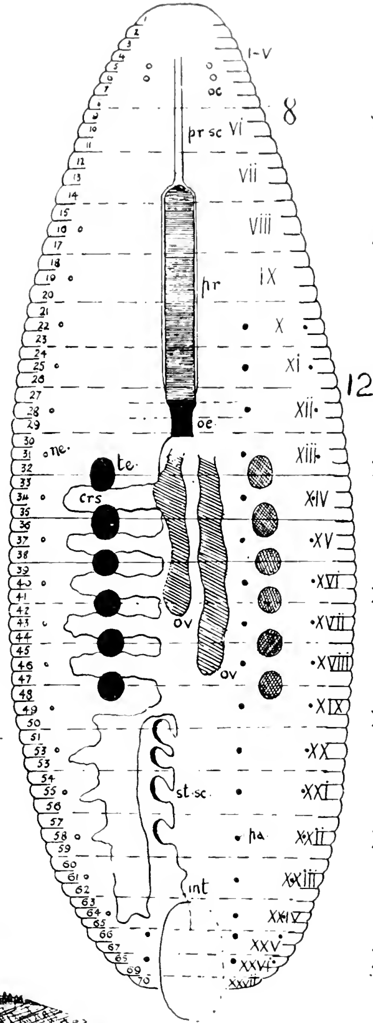
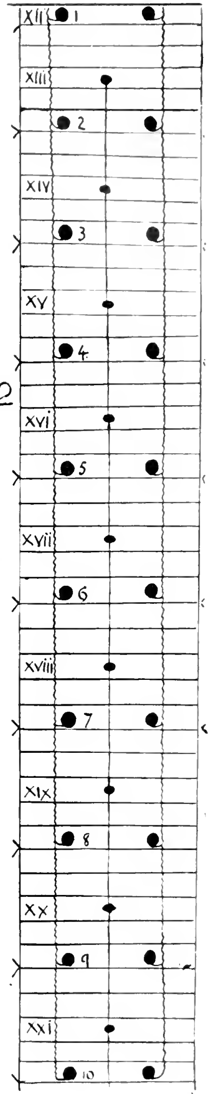
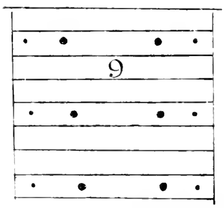


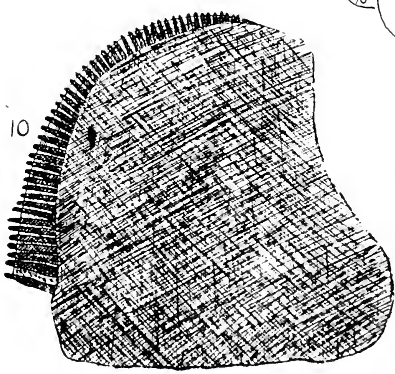
FIGS. 1, 2 & 6. GLOSSIPHONIA. FIGS. 3-5, LIMNOBDELLA.

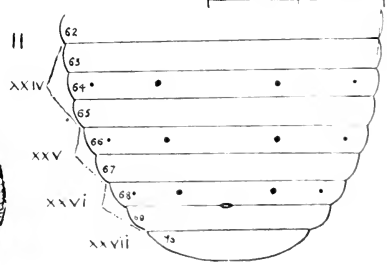




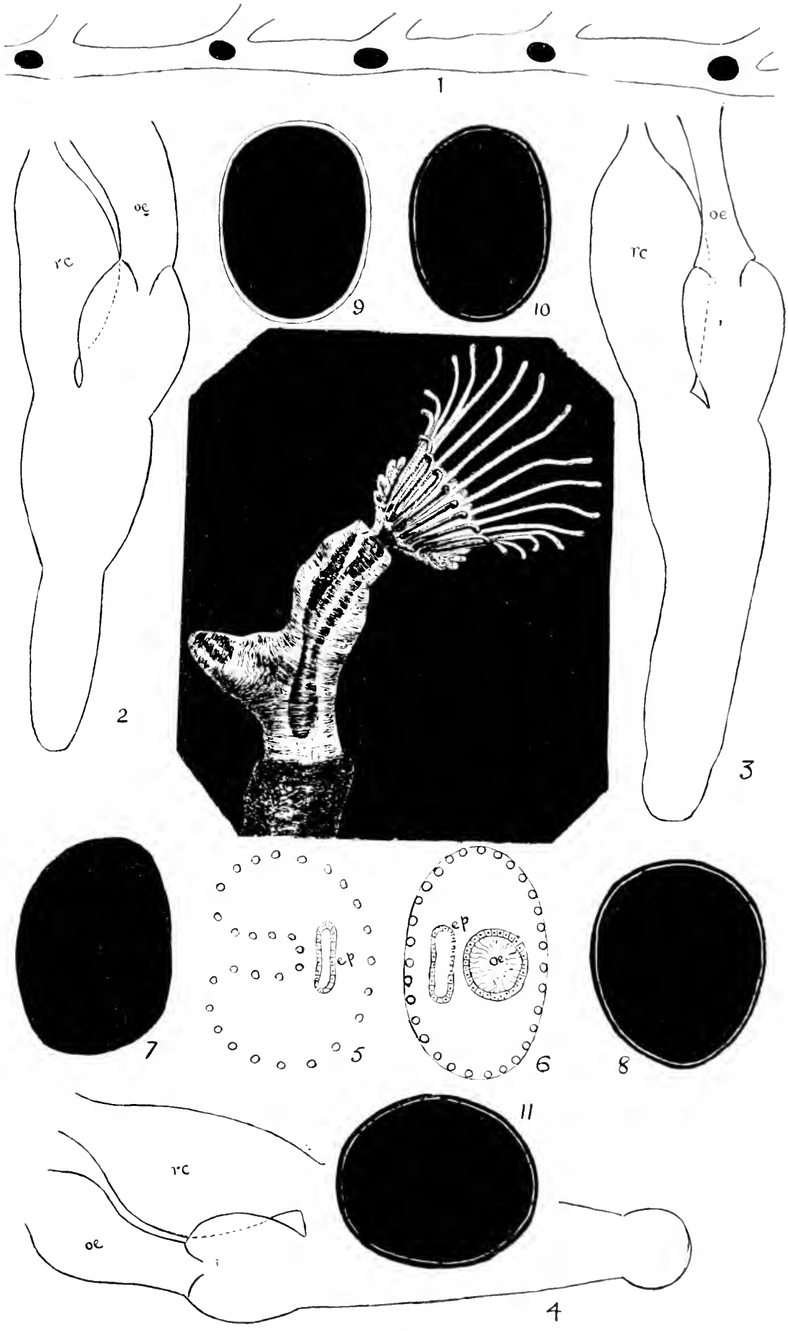




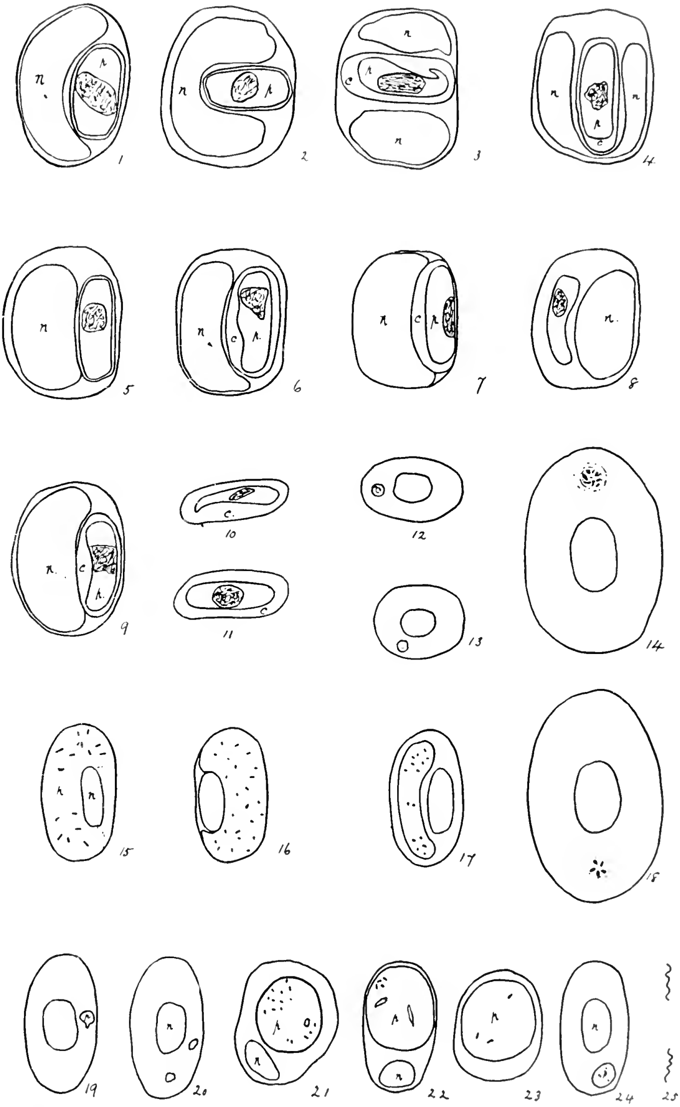




FIGS. 7, 10, 12, LIMNOBDELLA   FIGS. 8, 9, 11, GLOSSIPHONIA.

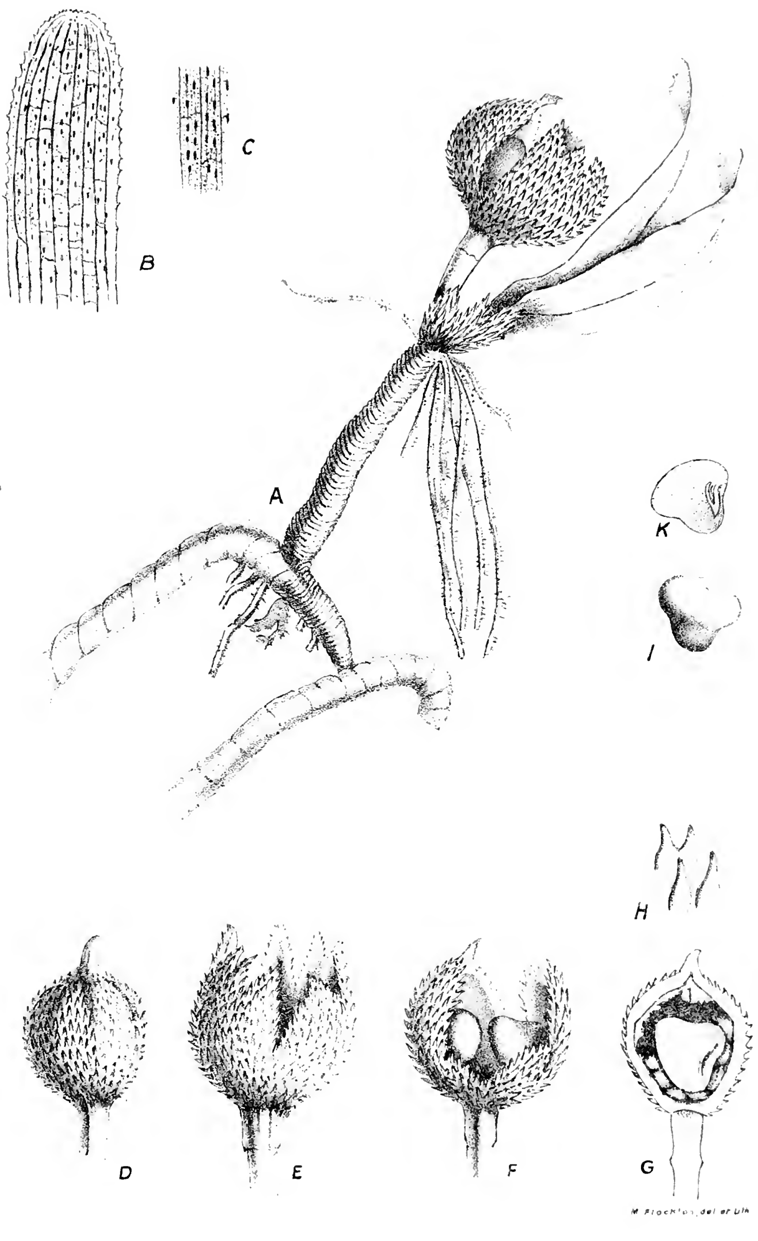


FREDERICELLA AUSTRALIENSIS, n sp.



T. H. J. del.

PARASITIC PROTOZOA.



CYMODOCEA CILIATA (FORSK.) EHRENB.

REVISION OF THE AUSTRALIAN CURCULIONIDÆ BELONGING TO THE SUBFAMILY *CRYPTORHYNCHIDES.*

Part X.

By Arthur M. Lea.

Parts ix. and x. deal with *Chætectetorus* and its allies, all of which belong to the "*Cryptorhynchides vrais*" of Lacordaire. Of the species recorded from Australia, I am acquainted with all except *Chætectetorus hædulus* Pasc., and *Gasterocercus nigroæneus* Chevr. The latter species probably does not belong to *Gasterocercus*, as M. Chevrolat proposed for it the generic name of *Coptoscelis*, without, however, giving a generic description.

A character made use of by Mr. Pascoe in his table, viz., "Rostrum curved" as against "Rostrum straight" is not to be relied on, as both *Menios* and *Metyrus* include species having the rostrum straight, and others having it more or less distinctly curved; in fact this character seldom appears to be of primary importance in the subfamily.

Exithius was regarded by Mr. Pascoe as being allied to *Chætectetorus*, probably on account of the clothing and shape of the prothorax; but the short metasternum (though longer than in *Tituacia**), very narrow metasternal episterna, excavated head, and partial soldering of the two basal segments of abdomen in middle, would seem to exclude it from all association with that genus and denote an approach to *Paleticus*.

In nearly all the genera the metasternum is elongate, and with large or comparatively large episterna. The mesosternal receptacle is subject to great variation, being decidedly open in some,

* It is with considerable doubt that I refer *Tituacia* to the group.

and as decidedly cavernous in others. In *Deretiosus* the pectoral canal is open at the apex, and terminates suddenly beyond the intermediate coxæ; but between these there is absolutely no part of the mesosternum that can come in contact with the sides of the rostrum or impinge on the coxæ. All the genera (with the exception of *Tituacia*) are winged.

The species (with very few exceptions) are either more or less cylindrical, or flat with an elliptic or elongate-elliptic outline. The majority are clothed with large soft scales, with larger and semierect ones (sometimes setose in character) intermingled: many of them have fascicles; on the prothorax, six in number; two at apex and four across middle; on the elytra they are less uniform.

The great majority of the species occur in heavy forest country, being very numerous in Queensland and the northern coastal rivers of New South Wales; many occur in Tasmania, the genus *Pseudometyrus* being almost confined to it. The bulk of the genera and species, however, are inhabitants of the Malay Archipelago and New Guinea.

A. Mesosternal receptacle absent................................ DERETIOSUS.
AA. Mesosternal receptacle open.
  a. Metasternum very short, eyes coarsely faceted..... .. TITUACIA.
  aa. Metasternum normal, eyes finely faceted.
    b. Tibiæ with terminal hook and subapical tooth..... EUTHYRRHINUS.
    bb. Tibiæ with terminal hook only.
      c. Rostrum longer than prothorax............... ..... ISAX.
      cc. Rostrum no longer than prothorax.
        d. Eyes subtriangular....................... .... CHIMADES.
        dd. Eyes round.
          e. Femora strongly dentate... .... PHLÆOGLYMMA.
          ee. Femora edentate, or only the middle pair dentate.. .... EPHRYCUS.
AAA. Mesosternal receptacle cavernous.
  B. Eyes finely faceted.
    f. Claw-joint short... METACYMIA.
    ff. Claw-joint long.
      g. Front femora (at least) edentate.
        h. Scrobes visible from above.... . ... WIBURDIA.
        hh. Scrobes not visible from above........ .... EPHRYCINUS.

gg. Front femora dentate.
i. Mesosternal receptacle with thin U-shaped walls.
j. Elytra conjointly mucronate at apex...... ODOSYLLIS.
jj. Elytra rounded or separately mucronate at apex.. TYCHREUS.
ii. Mesosternal receptacle stouter and more or less raised and vaulted.
k. Rostrum thin... .. .. PSEUDOMETYRUS.
kk. Rostrum stout.............................. METYRUS.
BB. Eyes coarsely faceted.
C. Metasternum shorter than first abdominal segment.
. Claw-joint squamose.................... .... CHÆTECTETORUS.
ll. Claw-joint glabrous, at most setose.
m. Femora dentate .... ACROTYCHREUS.
mm. Femora edentate.
n. Prothorax very feebly produced at apex and not impinging on head........ .... MENIOMORPHA.
nn. Prothorax distinctly produced at apex and overhanging head................................ METYRCULUS.
CC. Metasternum longer than first abdominal segment.
D. Prothorax more or less deeply excavated on disc PSEUDAPRIES.
DD. Prothorax convex..................................... MENIOS.
DDD. Prothorax flat.
E. Tibiæ with terminal hook only.
o. Body squamose.
p. Femora edentate............................ .. ACHOPERA.
pp. Femora dentate............. .... ACHOPERINUS.
oo. Body glabrous...... .... BEPHARUS.
EE. Tibiæ with terminal hook and subapical tooth.
F. Tibiæ very strongly ridged......................... SYMPIEZOSCELUS.
FF. Tibiæ compressed but not ridged........... MITRASTETHUS.

Notes on the above Table.

AAA.—In *Tychreus* the receptacle appears (in the majority of species) to be open or nearly so, but when probed with a pin, it is seen to be slightly cavernous.

C.—Along middle, sometimes the reverse is the case at the sides.

MENIOMORPHA Lea, Mém. Soc. Ent. Belge, xvi., 1908, p.177.

MENIOMORPHA INCONSTANS Lea, *l.c.* p.178.

Hab.—Queensland.

ISAX, MENIOS, PSEUDOMETYRUS, METYRUS, WIBURDIA.

As these genera are closely allied, it is thought best (to avoid repetition) to give the characters they possess in common, as follows :—

Head convex, not entirely concealed by prothorax; ocular fovea moderately distinct. *Eyes* moderately large, widely separated. *Prothorax* transverse; ocular lobes obtuse. *Scutellum* distinct. *Elytra* convex, cylindrical, base trisinuate, shoulders square. *Metasternum* large, longer than basal segment of abdomen; episterna distinct. *Abdomen* with distinct sutures, intercoxal process rounded, 1st segment as long as 2nd-3rd combined, 3rd-4th conjointly longer than 2nd but much longer than 5th. *Legs* moderate; tibiæ compressed, straight or feebly bisinuate beneath; tarsi moderately long, 3rd joint wide, deeply bilobed, claw-joint elongate. Convex, cylindrical, squamose, punctate, fasciculate, winged. Although closely allied, the following table should render their separation easy :—

Pectoral canal open, rostrum longer than prothorax...... ISAX.
Pectoral canal closed, rostrum the length of prothorax.
  Eyes coarsely faceted.......... .... MENIOS.
  Eyes finely faceted.
    Rostrum thin........ .... PSEUDOMETYRUS.
    Rostrum stout.
      Femora dentate..... .... METYRUS.*
      Femora edentate.................. .... WIBURDIA.

* In this genus the claw-joint is stouter than in the others.

Genus ISAX Pascoe, Journ. of Ent. 1865, p.429.

Head rather small. *Eyes* finely faceted. *Rostrum* straight or slightly curved, slightly longer than prothorax, very thin and rounded. *Antennæ* thin: scape slightly shorter than funicle, inserted either slightly nearer apex than base of rostrum or *vice* *versâ*; two basal joints of funicle elongate; club small, ovate. *Prothorax* suddenly narrowed and tubular at apex, sides rather strongly rounded and feebly decreasing to base. *Elytra* noticeably wider than prothorax, apex feebly emarginate. *Pectoral canal* narrow, deep, terminated at metasternum. *Mesosternal receptacle* twice as long as wide, walls very thin; open. *Femora* dentate, scarcely visibly grooved.

The long thin rostrum, and long and open mesosternal receptacle render this genus very distinct.

Convex; prothorax fasciculate, not carinate; rostrum straight, mesosternal episterna densely punctate...... *gallinago* Pasc.
Flattened; prothorax carinate, not fasciculate; rostrum slightly curved; metasternal episterna with one row of punctures in middle.. .... *planipennis* Lea.

ISAX GALLINAGO Pasc.; Mast. Cat., Sp. No. 5562.

Black, opaque, rostrum piceous, antennæ and claws dull red. Densely clothed all over with minute sooty-brown and testaceous scales; with a transverse row of four sooty fascicles across middle of prothorax, and one on each side of apex; 2nd interstice with two elongate fascicles, 4th with three very much smaller and a moderately large one near apex; undersurface with sooty and testaceous scales, extreme base of rostrum squamose.

Head with ocular fovea rather indistinct and longitudinal; eyes almost round. Rostrum long, thin, rounded, straight, shining; base densely punctate, elsewhere sparsely and somewhat irregularly punctate. Scape short, inserted slightly nearer base than apex of rostrum, not extending to apex; two basal joints of funicle elongate, 1st as long as 2nd-3rd, 3rd as long as 4th-5th, 7th distinctly transverse. *Prothorax* transverse, convex, apical third tubular, apex itself feebly emarginate, sides rounded; densely covered with small shallow punctures. *Scutellum* oblong, raised, feebly shining. *Elytra* almost thrice the length of prothorax, and noticeably wider, subparallel to near apex, convex; shoulders subtuberculate; each with about seven obsolete tubercles supporting fascicles, two elongate ones on the 2nd interstice, of which the 1st is near base and 2nd slightly before middle; 4th interstice with three small tubercles before middle and a somewhat prominent one on posterior declivity; suture feebly raised throughout, basal two-thirds margined with small shining granules; striate-punctate, punctures more or less obscured by scales, very small on posterior declivity; interstices wider than punctures; apex feebly emarginate, in some specimens (owing to clothing) appearing entire. *Metasternal episterna* densely punctate, punctures squamose. *Legs* densely punctate, anterior femoral teeth somewhat acute, posterior somewhat obtuse; posterior femora extending to apex of 3rd segment. Length $10\frac{1}{2}$; rostrum 3; width 5(vix)mm.

Hab.—Queensland—N.S.W.: Forest Reefs.

A specimen from Mt. Kosciusko differs in being somewhat smaller, in having the rostrum not perfectly straight, and in having the punctures much more distinct. Length 9, rostrum $2\frac{2}{3}$; width $4\frac{1}{4}$ mm.

This species may be readily distinguished from the following by its fasciculate and non-carinate prothorax, convex form, and puncturation of metasternal episterna. In the Kosciusko specimen the rostrum appears to be perfectly straight, but, on looking at it from the side, a very slight curvature is noticeable.

ISAX PLANIPENNIS Lea, Ann. Soc. Ent. Belge, 1909, p. .

Hab.—New South Wales.

Genus MENIOS Pascoe, Trans. Ent. Soc. London, 1870, p.475.

Head moderately large, somewhat flattened. Eyes coarsely faceted. Rostrum moderately stout, somewhat flattened, straight or feebly curved, sides very feebly incurved to middle. Antennæ moderately stout; scape shorter than funicle, inserted at or about middle of sides of rostrum. *Prothorax* rounded towards apex, but not suddenly narrowed and subtubular. *Scutellum* suboblong. *Elytra* but slightly, and not suddenly, wider than prothorax. *Pectoral canal* moderately wide and deep, terminated between four front coxæ. *Mesosternal receptacle* raised, base thick, emargination strongly transverse; cavernous. *Femora* dentate, slightly grooved.

The claw-joint is described by Pascoe as "haud squamoso"; on all the specimens before me, there are certainly no true scales, but on some of them this joint is rather strongly setose.

Rostrum perfectly straight.
- Less than 5 mm. in length.................................. *sordidatus* Lea.
- More than 5 mm. in length. .... *internatus* Pasc.

Rostrum slightly but distinctly curved.
- Each elytron at base with a very obscure fascia....... *nebulosus*, n.sp.
- Each elytron with two very distinct pale oblique fasciæ.. *albifasciatus*, n.sp.

MENIOS INTERNATUS Pasc.; Mast. Cat., Sp.No.5520.

The largest(6-7 mm.) species of the genus, with the flat rostrum of *M. sordidatus*, and with clothing of the same nature, although somewhat different in colour.

Hab.—New South Wales and Victoria.

MENIOS SORDIDATUS Lea, Proc. Roy. Soc. Vict. xx. n.s., 1908, p. 193.

Hab.—New South Wales; King Island; West Australia.

MENIOS NEBULOSUS, n.sp.

Piceous; rostrum and antennæ reddish; rostrum shining in ♀, opaque in ♂. Densely clothed with soft scales varying from ochreous to dark brown, and very variable individually; scales on flanks of prothorax usually paler than on disc; elytra usually with an oblique whitish fascia behind each shoulder almost to suture; under surface with dingy ochreous-brown scales longer than on upper surface. Prothorax with six indistinct fascicles; 3rd and 5th interstices of elytra with feeble fascicles.

Rostrum rather distinctly curved, sides feebly incurved to middle; in ♂ coarsely, in ♀ rather feebly punctate; punctures visible except at extreme base in ♀, on apical third only in ♂. Scape inserted almost in exact middle. *Prothorax* moderately transverse, sides gently rounded almost from apex to base; with dense round punctures, only partially concealed by scales *Elytra* closely applied to prothorax and slightly wider; striate-punctate, striæ rather feeble, punctures moderately distinct, each containing a scale; alternate interstices scarcely visibly raised; preapical callus scarcely traceable. Punctures of *under surface* and legs slightly traceable. *Femora* moderately strongly and equally dentate, posterior extending to penultimate segment. Length $4\frac{3}{4}$, rostrum 1; width $1\frac{3}{4}$ mm.

Hab.—W.A.: Albany (R. Helms), Mt. Barker, Pinjarrah, Vasse, Bridgetown(A. M. Lea).

The eyes in this and the following species are smaller and more widely separated than in the preceding; the scales on the prothorax are more or less erect; in the preceding each puncture appears to have a scale completely covering it; on the 3rd, 5th, and 7th interstices there are more or less distinct series of stout suberect scales.

MENIOS ALBIFASCIATUS, n.sp.

Piceous-red, antennæ paler; apical third of rostrum feebly shining. Densely clothed with soft scales of a dingy white on the under surface, legs, between the eyes and on rostrum; on the upper surface pale brown and white, the white scales clothing the sides of prothorax, from which they are continued on to shoulders, thence obliquely in widening fasciæ to suture (so that a somewhat ovate patch of brown scales is enclosed on the elytra and prothorax), an oblique fascia continued from each side to summit of posterior declivity, apex with whitish scales. Prothorax with apical fascicles not traceable, and the median traceable with difficulty; elytra not fasciculate.

Rostrum moderately curved, sides incurved to middle, base wider than apex; rather coarsely punctate, punctures concealed in front of antennæ. Scape inserted slightly nearer apex than base of rostrum. *Prothorax* feebly transverse, base bisinuate, apex rather narrow, sides rounded and gently decreasing to base from behind middle; densely punctate, each puncture concealed by a soft and gently concave scale. *Elytra* considerably wider than prothorax at base, but very little wider than in middle; striate-punctate, striæ distinct, punctures almost entirely concealed, 3rd and 5th interstices very distinctly raised. Punctures of *under surface* and legs almost entirely concealed. *Femora* acutely and equally dentate, posterior extending to apical segment. Length $4\frac{3}{4}$, rostrum $\frac{4}{5}$; width $2\frac{1}{6}$ mm.

Hab.—Q.: Endeavour River (Macleay Museum).

In this species the scape is inserted slightly (but sufficiently distinctly) nearer base than apex; it and *Metyrus albicollis* are the only ones in the group having the scales in distinct patterns. Neither the prothorax nor elytra could truly be called fasciculate, but in addition to the ordinary scales there are a number of stout semierect ones on the flanks of prothorax and alternate interstices of elytra.

Genus PSEUDOMETYRUS Lea, Ann. Soc. Ent. Belge, 1909, p. .

Rostrum perfectly straight.
- Prothorax not wider across middle than at base..... ... *laminatus* Lea.
- Prothorax wider across middle than at base.
  - Elytra but slightly wider than prothorax and thrice as long........ .... *sirius* Er.
  - Elytra considerably wider than prothorax and less than thrice as long................ .... *antares* Er.

Rostrum slightly curved.*
- Scape (if anything) inserted slightly nearer base than apex of rostrum........... .... *placidus*, n.sp.
- Scape inserted distinctly nearer apex than base.
  - Elytra but slightly wider than prothorax and thrice as long................ .... *cylindricus*, n.sp.
  - Elytra considerably wider than prothorax and less than thrice as long.
    - Rostrum parallel-sided (or almost so).......... ...... *persimilis*, n.sp.
    - Rostrum considerably wider at base than apex..... *vicarius*, n.sp.

PSEUDOMETYRUS LAMINATUS Lea, *l.c.* p. .

Hab.—New South Wales.

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* When seen in profile, from above it appears to be straight.

PSEUDOMETYRUS SIRIUS Erichs.; Mast. Cat., Sp. No.5549.

(*Cryptorhynchus* Erichs.).

Black, antennæ dull red; rostrum opaque in ♂, shining in ♀. Moderately densely clothed with rather elongate brown scales, paler on prothorax (where they are parted along middle) than on elytra; under surface and legs with paler and rather more elongate scales than those of upper surface. Prothorax with six distinct fascicles; elytral tuberosities rather feebly fasciculate, apex with four minute fascicles.

Rostrum straight; in ♂ decreasing in width from base to near apex, in ♀ rather suddenly decreasing to antennæ and thence parallel-sided to apex; in ♂ coarsely punctate, but the punctures more or less concealed, in ♀ rather finely punctate except on basal fourth. Scape inserted two-fifths from apex in ♀, slightly nearer in ♂. *Prothorax* with dense round punctures only partially concealed; subtuberculate beneath fascicles; feebly impressed along middle and on each side between fascicles. *Elytra* slightly wider than prothorax and fully thrice as long; striate-punctate, striæ feeble towards suture, more distinct towards sides, punctures not very large; interstices wider than punctures, the alternate ones irregularly raised and subtuberculate; preapical callus (on 5th interstice) distinct. *Under surface* and legs with dense round punctures, only partially concealed by clothing; each of the metasternal episterna with an irregular double row. *Legs* moderately long and rather thin; anterior femora feebly, the four posterior rather strongly dentate; posterior extending to apical segment; anterior tibiæ rather thin, finely serrate beneath. Length 11, rostrum $2\frac{1}{3}$; width $4\frac{2}{3}$ mm.

Hab.—Tasmania.

This species and *P. cylindricus* are thinner and more cylindrical than the others. Mr. Masters informs me that Mr. Pascoe had specimens of this species, and that he referred them to *Isax*, and gave them an MS. name.

Pseudometyrus antares Erichs.; *l.c.* No.5539.

Cryptorhynchus antares Erichs.

Black, antennæ dull red; rostrum opaque in ♂, shining and somewhat diluted with red in ♀. Moderately densely clothed with ochreous-brown and rather elongate scales, paler and longer on under surface and legs than on upper surface; a patch of whitish scales in middle of base of prothorax and a more or less distinct subquadrate patch at apex of elytra. Prothorax with six fascicles, each elytron with about six moderately distinct and a few feebler ones, a small fascicle on each side of apex.

Rostrum straight; in ♂ decreasing in width to antennæ, in ♀ suddenly decreasing half-way to antennæ, thence parallel-sided to apex; in ♂ coarsely and irregularly punctate to apex, in ♀ apical three-fourths almost impunctate. Scape inserted three-sevenths from apex in ♂, slightly nearer middle in ♀. *Prothorax* with dense round punctures, not entirely concealed by clothing, the tubular apex shorter than in preceding species: feebly tuberculate beneath fascicles. *Elytra* considerably wider and less than thrice the length of prothorax: striate-punctate, striæ feeble, punctures rather large, 3rd and 5th interstices feebly tuberculate beneath fascicles, but not raised to any extent. *Under surface* and legs with dense round more or less concealed punctures; metasternal episterna irregularly punctate. *Femora* moderately strongly and almost equally dentate; posterior extending to middle of apical segment in ♂, scarcely so far in ♀. Length 9, rostrum $2\frac{1}{6}$; width 4 mm.

Hab.—Tasmania.

Dr. Erichson describes the prothorax as having three sordid white lines; on one of the specimens under examination these lines are just traceable; on another the white scales at apex of elytra form a very distinct patch.

Pseudometyrus placidus, n.sp.

♀. Black, rostrum and antennæ dull red; rostrum shining. Clothing and fascicles as in the preceding except that (at least in the specimens under examination) the scales at apex of elytra are but slightly paler than the others.

Rostrum very feebly curved, suddenly decreasing in width to near antennæ; rather finely punctate except at basal third. Scape inserted slightly nearer base than apex of rostrum. *Prothorax*, *elytra* and *legs* as in the preceding species. *Under surface* and legs rather densely punctate, punctures partially concealed; each of the metasternal episterna with a single row of punctures in middle, but dense at base and apex. Length $5\frac{1}{4}$, rostrum $1\frac{1}{2}$; width $2\frac{1}{3}$ mm.

Hab.—Tas.: Launceston (A. Simson, No.3204).

Closely resembles the preceding in appearance, but is considerably smaller, scape inserted nearer base of rostrum, etc.

PSEUDOMETYRUS CYLINDRICUS, n.sp.

♂. Piceous; antennæ dull red; rostrum opaque. Clothing and fascicles as in *P. sirius*, except that there are only two small fascicles at apex of elytra.

Head densely punctate, punctures partially visible. Rostrum feebly curved, gently decreasing in width from base to apex, densely and irregularly punctate, the punctures more or less concealed behind antennæ; with three feeble and feebly waved carinæ. Scape inserted one-third from apex of rostrum. *Prothorax* as in *P. sirius*. *Elytra* slightly wider than prothorax and fully thrice as long; striate-punctate, striæ feeble, punctures rather large but almost concealed; 3rd, 5th, and 7th interstices irregularly raised and in places subtuberculate; preapical callus larger than in *P. sirius*. *Under surface* and legs with dense partially concealed punctures; each metasternal episternum with a triple row of punctures. *Legs* rather long; femora strongly (posterior less noticeably) dentate; posterior extending to apical segment; anterior tibiæ rather strongly serrate. Length 8, rostrum $1\frac{4}{5}$; width 3 mm.

Hab.—Tasmania (A. Simson, No.2853), Hobart (H. H. D. Griffith).

Looks much like a small specimen of *P. sirius*. The rostral carinæ can be seen distinctly only between the antennæ.

Pseudometyrus persimilis, n.sp.

♂. Piceous, rostrum and antennæ red; rostrum opaque. Moderately densely clothed with dingy ochreous-brown scales, paler and denser on sterna and legs than elsewhere. Prothorax with six fascicles, each elytron with about six moderately distinct ones.

Rostrum feebly curved, rather thin, parallel-sided (or almost so) from base to apex. Scape rather stout, inserted two-fifths from apex. *Prothorax* feebly punctate, subtuberculate beneath fascicles. *Elytra* wider than and less than thrice the length of prothorax; striate-punctate, striæ feeble, punctures rather large, round, each containing a scale; interstices not alternately raised, the 3rd and 5th tuberculate beneath fascicles. *Under surface* and legs rather less densely punctate than usual. *Femora* rather strongly dentate, the posterior less strongly than the others. Length $4\frac{3}{4}$, rostrum 1; width $2\frac{1}{5}$ mm.

Hab.—New South Wales(Macleay Museum).

This and the following species are very closely allied, but they must be regarded as distinct, not only on account of the sides of rostrum and punctures, but because in this species the eyes are smaller and less rounded.

Pseudometyrus vicarius, n.sp.

♂. Piceous-red; rostrum and antennæ red; rostrum opaque. Moderately densely clothed with ochreous-brown scales, paler on prothorax and apex of elytra than on the rest of elytra; scales of under surface and legs similar to those of prothorax. Prothorax with six fascicles, of which the two apical are scarcely traceable; each elytron with about six moderately distinct fascicles.

Eyes rather larger and more convex than usual. Rostrum feebly curved, rather suddenly decreasing from base to antennæ, moderately coarsely punctate towards apex, punctures concealed behind antennæ. Scape inserted two-fifths from apex. *Pro-*

thorax, elytra, under surface and *legs* much as in *P. antares*. Length $3\frac{2}{3}$, rostrum $\frac{3}{4}$; width $1\frac{2}{3}$ mm.

Hab.—Tasmania. Type in Mr. A. Simson's Collection.

The apex of the rostrum is less coarsely punctate than is usually the case in males of this genus. The species strongly resembles *P. antares* in miniature.

Genus METYRUS Pascoe, Journ. Linn. Soc. Zool. xi. 1872, p. 482.

Head large. *Eyes* finely faceted. *Rostrum* stout, feebly curved, the length of prothorax, apex slightly wider than middle. *Antennæ* stout; scape shorter than funicle, inserted nearer apex than base; funicle with two basal joints stout and not very long; club rather large. *Prothorax* rather suddenly narrowed towards and subtubular at apex; basal two-thirds subparallel. *Elytra* slightly wider than prothorax. *Pectoral canal* rather wide, terminated between four anterior coxæ. *Mesosternal receptacle* raised; emargination widely transverse; decidedly cavernous. *Femora* grooved and dentate.

METYRUS ALBICOLLIS Germ.; Mast. Cat., Sp. No. 5538.

Cryptorhynchus albicollis Germ.; *Metyrus collaris* Pasc., *l.c.*, No. 5416.

Piceous-black. Densely clothed with chocolate-brown scales, becoming subfasciculate in places on the elytra; prothorax (except at extreme apex and sides and a large round spot on each side of base), each shoulder and an apical spot on each elytron, with whitish scales. Middle of metasternum, a spot on each side of mesosternum, a trident shaped patch on abdomen and under surface of femora with whitish scales; femora and tibiæ feebly ringed. Prothorax with seven fascicles: two at apex (half white and half brown) and five across middle (all white), the middle one supported on an enlargement of the median carina; elytra with numerous small fascicles, but a very distinct one on each side of scutellum.

Head densely punctate, punctures more or less concealed; vertex feebly impressed. Rostrum densely, coarsely, and irregularly punctate. Scape inserted one-third from apex of rostrum; 1st joint of funicle as long as 2nd-3rd combined; club as long as six preceding joints. *Prothorax* moderately transverse, sides rounded, base feebly bisinuate; tuberculate beneath fascicles; with a distinct median carina (clothed with white scales to base) from apical third to extreme base; densely punctate, punctures concealed. *Elytra* very slightly wider than prothorax, apex rounded; subtuberculate beneath fascicles; striate-punctate, striæ feeble, punctures large, round and partially concealed. *Under surface* with dense but entirely concealed punctures. *Legs* short; femora grooved, but the grooves almost concealed, four anterior moderately dentate, the posterior almost edentate and scarcely extending to apical segment. Length 10, rostrum $2\frac{1}{3}$; width 5 mm.

Hab.—West and South Australia; Victoria; Queensland.

The clothing alone is sufficient to render this a very distinct species. In addition to the pale scales noted, a small fascicle at summit of posterior declivity is supplied with a few pale scales. One of the Victorian specimens was taken from a mistletoe.

Genus WIBURDIA Lea, Proc. Roy. Soc. Vic. xx. 1908, p.196.

WIBURDIA SCROBICULATA Lea, *l.c.* p.196.

Hab.—New South Wales; Victoria; King Island.

PSEUDAPRIES Lea, Mém. Soc. Ent. Belge, xvi., 1908, p.182.

The species of this genus may be tabulated as follows:—

Hind femora strongly dentate.
- Walls bounding median groove impressed in middle... *gronopoides* Pasc.
- Walls not so impressed.
  - Femora not grooved.. *ptychoderes*, n.sp.
  - Front femora feebly grooved. .... *corticalis* Lea.
  - Four front femora feebly grooved........................ *nebulosus*, n.sp.

All femora edentate.
- Prothorax with four longitudinal crests of stout scales separated by deep channels. .... *jubatus*, n.sp.

Prothorax without four such crests.
  Prothorax longitudinal.................................... *elumbis*, n.sp.
  Prothorax transverse.
    Prothorax with four discal foveæ..................... *foveicollis*, n.sp.
    Prothorax with median channel scarcely constricted in middle..... .... *pediculosus* Lea.

PSEUDAPRIES CORTICALIS Lea, *l.c.*, p.184.

Hab.—Queensland and New South Wales.

PSEUDAPRIES PTYCHODERES, n.sp.

Differs from preceding species in being larger, wider, the prothorax more transverse, elytra subcordate, front femora not grooved, the large scales more numerous on the prothorax and sparser on the elytra. Length 5, rostrum 1; width $2\frac{1}{3}$ mm.

Hab.—New South Wales: Richmond River(A. M. Lea).

On comparing this species with *P. corticalis*, it can at once be seen to be distinct, although the clothing and sculpture are very similar. The following species appears also to be distinct. The three species are very closely allied, but I think they should be treated as distinct species rather than as three forms of one species.

PSEUDAPRIES NEBULOSUS, n.sp.

Differs from *P. corticalis* in being smaller, narrower, the prothorax slightly longer than wide, and the four front femora feebly grooved. The clothing is considerably darker, the stout scales are much more numerous; on the prothorax they are not confined to the sides and apex, and on the elytra they are nearly as numerous towards base as towards apex, and are not confined to the interstices. The under surface and legs are supplied with more numerous setose scales, and the darker rings on the legs are scarcely traceable. Length 3, rostrum $\frac{2}{3}$; width $1\frac{1}{2}$ mm.

Hab.—Queensland: Cooktown(J. Faust).

PSEUDAPRIES ELUMBIS, n.sp.

Piceous-red, antennæ and claw-joints dull red; scape much darker than funicle. Densely clothed, except at apex of rostrum.

Prothorax with pale fawn-coloured scales, the base with a patch of sooty scales, sides and apex with stout semi-erect scales, not at all fasciculate in arrangement. Elytra with sooty scales; the shoulders, beyond middle, and at apex with paler scales; the alternate interstices with very stout but rather indistinct scales, apex and sides towards apex with subsetose and semierect scales. Under surface with almost uniformly coloured pale scales and with numerous subtriangular stouter ones; legs variegated with sooty scales.

Rostrum rather short, finely punctate, punctures concealed except at apex. Scape stout, inserted distinctly nearer base than apex of rostrum, the length of two basal joints of funicle; 1st joint of funicle not twice the length of 2nd. *Prothorax* slightly longer than wide, apex considerably more than half the width of base, disc with a dumbbell-shaped excavation; constriction deep, continued on to disc and thence as an excavation nearly to base on each side, a smaller subelliptic excavation on each side between median and lateral excavations. *Elytra* not much wider than prothorax, sides feebly decreasing from near base; seriate-foveate, foveæ round and close together, appearing as large punctures through clothing; 3rd, 5th, and 7th interstices feebly raised. Basal segment of *abdomen* with a semicircular row of fourteen very large punctures, almost concealed by clothing. *Femora* feebly grooved, edentate. Length 4, rostrum $\frac{2}{3}$; width $1\frac{1}{2}$ mm.

Hab.—Queensland: Endeavour River (G. Masters), Cooktown (J. Faust).

The paler scales vary from almost white to dark fawn; the elytra occasionally appear as if adorned with four rather feeble whitish spots. In appearance the species is like *Achopera lachrymosa.*

In general appearance very close to two specimens sent to me by Dr. Gestro as cotypes of *Chætectetorus histrio* Pasc., (and which if correctly named, as I see no reason to doubt, is referable to *Pseudapries*) but wider and with more of the surface covered with dark scales. The prothoracic impressions are also more noticeable, though this is due largely to the clothing. Pascoe does not mention the sculpture of the prothorax of *C. histrio*, but in the specimens before me it is evidently much as in *P. elumbis*, although the clothing is so dense, that, without knowing what to look for, the grooves could easily be overlooked. In the table given above it would be placed next to *P. elumbis*.

Pseudapries foveicollis, n.sp.

Rostrum piceous; antennæ and tarsi dull piceous-red. Densely clothed with large, soft, pale, fawn-coloured scales, feebly mottled on the elytra but perfectly uniform in colour on prothorax. Prothorax at apex and sides, and elytra on alternate interstices, with stout and rather sparse suberect scales.

Rostrum moderately long, not very thin, parallel-sided, punctures entirely concealed. Scape short, inserted slightly nearer base than apex of rostrum, almost one-half the length of funicle and club combined. *Prothorax* feebly transverse, apex more than half the width of base, constriction deep and well defined; with four discal foveæ, which are almost equal in size, the two lateral isolated, the two median feebly connected along middle; base strongly bisinuate. *Elytra* not much wider than prothorax and twice as long, sides subparallel to near apex; striate-punctate, striæ distinct, punctures almost concealed, suture and alternate interstices scarcely visibly raised. Punctures of *under surface* and legs entirely concealed. *Femora* thinner than usual, edentate and not grooved. Length $5\frac{2}{3}$, rostrum $1\frac{2}{5}$; width $2\frac{1}{6}$ mm.

Hab.—N.W.A.: Roebuck Bay.

A very distinct species; the specimen described was kindly given to me by Rev. T. Blackburn (No.4689), who received it from Mr. J. J. Walker. The median prothoracic excavation is almost obsolete in the middle, but becomes foveate at each end, so that the disc appears to be supplied with four almost equal-sized foveæ.

Pseudapries jubatus, n.sp.

Piceous-red, antennæ and claw-joints red. Densely clothed with scales of a uniform and rather dark fawn. Head and base of rostrum (the apical half glabrous) with semierect scales, larger at sides of rostrum than elsewhere. Prothorax with four very distinct and rather wide longitudinal crests of erect scales, all of which are large, but those along the centre of the crests very large, the two outer crests continued to constriction, the two median joined together at the base. Elytra with large soft scales, the suture, 3rd and 5th interstices, and shoulders with crests somewhat as on prothorax, but smaller and the scales composing them less uniform in size. Undersurface and legs with rather large soft scales, intermingled with numerous suberect setose ones.

Head feebly depressed between eyes. Rostrum not very short, parallel-sided; densely and moderately strongly punctate; apparently feebly costate towards base. Scape inserted one-third from base of rostrum, slightly longer than two basal joints of funicle, these subequal in length. *Prothorax* distinctly transverse, apex about half the width of base; longitudinally excavated at sides and middle, median excavation closed posteriorly by scutellar lobe, the lateral excavations open at base and apex. *Elytra* about once and one-third the width of prothorax, sides subparallel to near apex; seriate-foveate, foveæ round and close together, but partially concealed; 3rd, 5th, and 7th interstices raised. Basal segment of *abdomen* with a semicircular row of ten very large punctures, which are almost concealed by clothing. *Femora* edentate, widely and feebly grooved. Length $5\frac{1}{2}$, rostrum $1\frac{1}{3}$; width $2\frac{2}{3}$ mm.

Hab.—New South Wales(J. Faust).

In this species the prothorax is differently sculptured and the 3rd tarsal joint is no wider than the 2nd, and is almost simple. It is possible that it should be regarded as the type of a new genus, but as in the other features, especially in the metasternum, it agrees very well with the four preceding species, I have not considered it advisable to separate it generically.

PSEUDAPRIES GRONOPOIDES Pasc.; Mast. Cat., Sp. No.5509.
(*Chætectetorus* Pasc.).

Dr. R. Gestro has kindly given me two cotypes of this species from Yule Island. It is certainly a *Pseudapries*, in general appearance being close to *P. corticalis*, but with the clothing looser, the large suberect scales larger and more numerous, and the prothorax slightly narrower, with somewhat different sculpture. The clothing is somewhat as in *P. nebulosus*, but that species also has the prothoracic sculpture different. The prothoracic impressions consist of a deep bilobed median channel, the walls of which are impressed across the middle; and each side with a sinuous impression opening out at the base half-way between the middle and the side, and in front at the side one-third from the apex: the whole prothorax in consequence appears to be covered with large, obtuse, coarsely squamose tubercles. Both specimens appear to be females, with the rostrum clothed only at the basal third, elsewhere being shining and with small but closely defined punctures. The hind femora are strongly dentate.

Hab.—Queensland: Somerset*—New Guinea: Yule Island.

P. PEDICULOSUS Lea.

Genus ACHOPERA Pascoe, Trans. Ent. Soc. 1870, pp. 473, 478.

Head somewhat flattened; ocular fovea small, usually concealed. *Eyes* small, round, coarsely faceted, distant. Rostrum moderately long, rather narrow, very feebly dilating to apex, curved. *Antennæ* short; scape short, inserted about middle of rostrum, terminating considerably before apex, its apex thickened; funicle more than twice the length of scape, two basal joints moderately long, 1st thick, 3rd-7th transverse; club briefly ovate or pyriform. *Prothorax* scarcely overhanging head, flattened or very feebly convex, slightly transverse, or slightly longer than wide; apex narrowed, somewhat produced and rounded, ocular lobes obtuse; constriction usually concealed. *Scutellum* small, distinct. *Elytra* feebly convex, wider than prothorax and about twice and one-half its length, base trisinuate; sides parallel to near apex; apex obtusely rounded. *Pectoral canal* rather deep and wide, terminated at base of anterior coxæ. *Mesosternal receptacle* depressed

* I have not seen Queensland specimens.

at base and narrow, apex raised and transversely semicircular; slightly cavernous. *Metasternum* slightly longer than 1st abdominal segment, produced between intermediate coxæ, emarginate at apex. *Abdomen* with distinct sutures; two basal segments large; 2nd smaller than 1st and encroaching on it at middle; three apical segments depressed, the third and fourth moderately large, conjointly longer than apical, and shorter than 2nd. *Legs* rather short; femora linear or sublinear, edentate, somewhat curved, posterior scarcely extending to apical segment of abdomen; tibiæ, in addition to terminal hook, with a small apical tooth; tarsi feebly setose beneath, narrow, shining, 3rd joint narrowly or moderately bilobed, 4th long, glabrous. Elongate, feebly convex, subparallel, punctate, striate, squamose, winged.

Achopera differs from *Chætectetorus* by the narrow tarsi, glabrous claw-joint, smoother prothorax, shorter scape and club, etc. All the species are considerably smaller than those belonging to *Chætectetorus*.

Elytra with alternate interstices raised........................ *alternata*, n.sp.
Elytral interstices regular.
  Prothoracic punctures distinct, prothorax and elytra
    with golden scales.. *xanthorrhϾ* Lea.
  Prothoracic punctures concealed, prothorax and elytra
    without golden scales.
    Basal segments of abdomen largely excavated in ♂ *lachrymosa* Pasc.
    Basal segments of abdomen flattened in ♂.......... *uniformis* Pasc.

ACHOPERA UNIFORMIS Pasc.; Mast. Cat., Sp.No.5518.

Piceous; abdomen dingy-red, antennæ and tarsi red. Densely clothed with muddy or ochreous-brown scales, and with semierect larger scales scattered about; elytra obscurely mottled with black scales. Under surface less densely clothed than upper, the scattered scales more numerous and thinner; legs clothed as upper surface but the elongate scales more numerous. Head and rostrum densely squamose, the latter with semierect scales at the sides.

Head with punctures entirely concealed, but ocular fovea moderately distinct. Rostrum wider at base than apex, feebly incurved to middle, punctures visible at apex. Scape the length of two basal joints of funicle. *Prothorax* slightly transverse, sides rounded, base bisinuate, apex narrowed and depressed, constriction continued across disc and in middle directed towards base, punctures concealed. *Elytra* subparallel to near apex; striate-punctate, punctures concealed. Basal segment of *abdomen* with a few large punctures on intercoxal process, almost concealed by scales; a very feeble depression continued on to it from metasternum. *Tibiæ* stouter or more densely squamose than in all the following species. Length $4\frac{1}{6}$, rostrum $\frac{3}{4}$; width $1\frac{4}{5}$ mm.

Hab.—Queensland: Wide and Moreton Bays.

The stoutest and most densely squamose species I am acquainted with.

ACHOPERA ALTERNATA, n.sp.

Dingy-red; under surface, antennæ, and claw-joints paler. Moderately densely clothed with ochreous scales; prothorax with numerous large black scales scattered about, and forming eight obscure tufts placed in two transverse series; elytra with ochreous and black scales rather well defined and regularly alternating, the 3rd interstice with seven patches on each. Under surface and legs with pale ochreous scales, the latter in addition with longer and paler scales. Head and rostrum not very densely closed, the latter with paler scales at base.

Head with punctures partially visible, but ocular fovea concealed. Rostrum narrower than in the preceding species, as wide at apex as at base, slightly incurved to middle. Scape slightly shorter than the two basal joints of funicle. *Prothorax* scarcely transverse; densely punctate, apical two-fifths subtubular, narrower than basal three fifths (which are rounded), somewhat depressed, and with straight sides. *Elytra* parallel to near apex; striate-punctate, punctures partially concealed, alternate interstices, especially the 3rd and 5th, raised; suture, especially on posterior declivity, thickened. *Under surface* densely punctate, punctures partially concealed; apex of basal segment of abdomen with a distinct depression, which is continued on to, but shallower on, 2nd. Anterior *tibiæ* shorter and stouter than posterior. Length $4\frac{1}{2}$, rostrum $\frac{4}{5}$; width $1\frac{2}{3}$ mm.

Hab.—N.S.W.: Sydney.

The specimen described appears to be a male; another, which I think is its female, is slightly larger and stouter, much more obscurely clothed, with the prothoracic tufts much less distinct and the punctures on the head entirely concealed. It appears to be close to *A. maculata*, but Mr. Pascoe's remark: "Elytris antice utrinque plaga magna alba decoratis" certainly does not apply to either of my specimens, and Mr. Pascoe could scarcely have overlooked the alternately elevated elytral interstices; moreover I think I have a damaged specimen of *A. maculata* which differs in a number of particulars.

Since the above was written, I have had under examination two Tasmanian specimens which belong to this species, but which differ in being slightly larger($5\frac{2}{3}$ mm.); in having the apex of the prothorax feebly bifasciculate, and the two fascicles in the middle of the base much more distinct than any of the others.

ACHOPERA XANTHORRHŒÆ Lea, Mém. Soc. Ent. Belge, xvi. 1908, p.180.

Hab.—West Australia.

ACHOPERA LACHRYMOSA Pasc.; Mast. Cat., Sp.No.5516.

Piceous; antennæ and claw-joints red, rostrum dull red, tibiæ obscurely variegated with red. Densely clothed with dingy black overlapping scales, variegated with dingy white or obscure ochreous; elytra with two small whitish spots slightly before the middle; with larger scales scattered about and which are concolorous with the scales amongst which they are placed, except on the elytra where they are sometimes paler. Under surface with dirty white scales, frequently with a high polish, and often obscurely variegated with black, brown, or ochreous scales; legs with more or less whitish scales; posterior femora with a black patch at outer base and sometimes at inner apex; all the tibiæ with two patches of black scales. Head densely squamose, the scales either uniformly muddy or dingy white, with two rather large blackish blotches; rostrum densely squamose at base, in ♂ scales feebly continued to apex; in ♀ glabrous from slightly before antennæ.

Head with punctures concealed, ocular fovea usually invisible. Rostrum slightly wider at base than at apex, feebly incurved to middle, finely punctate. Scape the length of two basal joints of funicle. *Prothorax* slightly transverse, less noticeably so in ♀ than ♂; sides rounded, apex narrow, the narrow portion about one-fifth of the total length, disc slightly convex, without visible punctures; occasionally (but very rarely) with a feeble median carina continuous from base to apex. *Elytra* very feebly increasing to beyong the middle in ♀, subparallel in ♂; striate-punctate, striæ and punctures larger and more distinct near base and suture than sides and apex, where the striæ are narrowed and the punctures entirely concealed. *Under surface* with large punctures on metasternum and abdomen; two basal segments of the latter flattened in ♀, largely excavated in ♂, the excavation in some species appearing to be continued both ways. Length 4, rostrum $\frac{3}{4}$; width $1\frac{2}{5}$; extremes $3\frac{1}{2}$-5 mm.

Hab.—Australia and Tasmania.

A very dingy species, with exceedingly variable clothing. The scales on the prothorax are black, but frequently with the sides and apex obscurely ochreous, occasionally with the disc ochreous, sometimes the ochreous scales predominating. The basal third of the elytra is usually black, but from thence to apex it is difficult to find two specimens exactly alike; just before the middle, however, there are usually two dingy white oblique spots; the interstices usually appear to be feebly longitudinally divided, owing to their being clothed with a double row of scales. The larger scales sprinkled about are scarcely suberect except at the apex of elytra; the black ones are sometimes highly polished and appear like small beads or granules. The suture in many specimens appears to be finely braided. The under surface, and especially the abdomen, is variable in regard to the colour of the scales. The median prothoracic carina is not constant, as in only seven out of sixty-three specimens have I been able to trace it. The species was originally described as coming from Tasmania; but in addition to that State, it is common under loose bark or under logs in dry situations in West and South Australia, Victoria, and New South Wales.

ACHOPERA MACULATA Pasc.; *l.c.* No.5517.

Hab.—New South Wales.

A specimen from Gosford agrees very well with Pascoe's description; but, as it is a damaged female, I refrain from describing it, and it is not included in the table.

TYCHREUS Pascoe, Trans. Ent. Soc. 1870, p.475.

Head moderately large, feebly convex; with or without ocular fovea. *Eyes* large, widely separated, finely faceted. *Rostrum* long, thin, curved, sides feebly incurved to middle. *Antennæ* moderately thin; scape shorter (sometimes considerably shorter) than funicle, inserted about middle of rostrum; funicle with 1st-2nd joints elongate, 1st decidedly longer and stouter than 2nd; club large, elongate-oval, as long as the five (sometimes as long as the six) preceding joints. *Prothorax* convex, moderately or feebly transverse, base bisinuate, sides suddenly narrowed towards apex, apex produced, overhanging head and less than one-half the width of base; ocular lobes prominent but somewhat rounded. *Scutellum* distinct. *Elytra* considerably wider than and raised above prothorax, base rather strongly bisinuate, shoulders rounded, sides parallel to beyond middle, and then suddenly and usually angularly decreasing to apex, apex usually conjointly or almost conjointly rounded. *Pectoral canal* not very wide, deep, terminated almost at metasternum. *Mesosternal receptacle* U-shaped, both as regards walls and emargination, scarcely raised, emargination either longitudinal or slightly transverse; almost open. *Metasternum* slightly shorter than basal segment of abdomen; episterna distinct. *Abdomen* moderately large, sutures distinct, 1st segment not longer (except in middle) than 2nd, intercoxal process rounded; 3rd and 4th combined slightly longer than 2nd or 5th. *Legs* not very long or stout; femora dentate, not grooved, posterior usually terminating just before apical segment of abdomen and never extending to apex; tibiæ compressed, curved at base; tarsi elongate, 3rd joint wide, deeply bilobed, claw-joint long, thin, and setose; claws thin. Elliptic or cylindrical or with an angular outline, convex, densely squamose, fasciculate, punctate, winged.

The species belonging to this genus appear to be borers in soft dead wood. *T. fasciculatus*(Lea) should not have been referred to *Tychreus*, and a new genus has been erected to receive it.

Scape inserted nearer base than apex of rostrum .... *reversus*, n.sp.
Scape inserted in middle of, or nearer apex than base of rostrum.
  Each elytron distinctly produced at apex .... *camelus* Pasc.
  Elytra conjointly rounded at apex (or almost so).
    Prothorax carinate.
      Apical fascicles of prothorax well defined.......... *coryssomerus* Lea.
      Apical fascicles almost absent.......................... *sellatus* Pasc.
    Prothorax non-carinate.
      Rostrum entirely black .... *furvus*, n.sp.
      Rostrum more or less red.
        Elytra but little wider than prothorax........... *fumosus*, n.sp.
        Elytra fully once and one-half the width of prothorax at base................................ *dilaticollis* Lea.

TYCHREUS CAMELUS Pascoe; Mast. Cat., Sp.No.5522.

Moderately long, convex, with an elongated-hexagonal outline. *Black*; antennæ (club excepted), tarsi and rostrum red. Densely clothed with soft scales of a greyish-brown colour, uniform on the under surface, but on the upper varying in places to a dark brown; head and base of rostrum densely clothed; legs densely clothed, the femora and tibiæ with obscure dark rings. Prothorax with six fascicles, two at apex and four across middle; elytra with numerous fascicles, some of which are isolated, the others being conjoined to form four oblique series, one from each shoulder and one from each side about the middle; a very large fascicle on the 3rd interstice about the middle which is almost twice as long as wide.

Rostrum with sides moderately incurved to middle; base moderately strongly punctate, apex finely punctate. Scape inserted almost in exact middle of rostrum, slightly shorter than funicle. *Prothorax* moderately transverse, apex rather suddenly narrowed and subtubular; feebly raised beneath fascicles; densely and strongly punctate, punctures round and concealed by clothing. *Elytra* considerably wider than prothorax, derm entirely concealed; shoulders oblique; apex triangularly emarginate, the apices with long scales; fascicles supported on tubercles, the large median fascicles boldly rising from a gentle slope; striate-punctate, striæ in places interrupted, the punctures large, but traceable with more or less difficulty. *Under surface* densely and moderately strongly punctate. Mesosternal receptacle longitudinal. *Femora* rather feebly dentate. Length 7, rostrum 2; width 3½; variation in length 6-7 mm.

Hab.—Tasmania.

In a specimen under examination, the scales of both upper and undersurfaces, and the legs are of a deep black, with the exception of a few white scales sprinkled about. Although the prothoracic punctures are concealed by the clothing, their outlines (especially at the sides) can be traced. In ♀, the rostrum is slightly longer, and the punctures are decidedly smaller than in ♂. In one specimen the elytral derm appears to be a dingy testaceous-yellow.

TYCHREUS FUMOSUS, n.sp.

Short, broad, convex, outline somewhat angular. Rostrum (in ♀, the aperture only in ♂), antennæ (club dark brown), apex of tibiæ, and tarsi reddish. Densely clothed with large soft scales of a greyish-brown colour, in places with a darker tinge; head and base of rostrum with pale and very pale brown scales; in addition the upper surface and legs with stout semierect scales. Under surface with whitish-grey scales. Prothorax with six fascicles; each elytron with from six to ten fascicles, of which the most distinct is on the 2nd interstice at summit of posterior declivity.

Head with very distinct ocular fovea. Sides of rostrum moderately incurved to middle; rather coarsely punctate at base in ♂. Scape slightly shorter than funicle, inserted nearer apex than base of rostrum. *Prothorax* rather strongly transverse; apex less tubular than in *T. camelus*; densely and strongly punctate, punctures round and concealed but their outlines more or less traceable. *Elytra* not much wider than prothorax, shoulders feebly rounded, apex almost conjointly rounded; subtuberculate beneath fascicles, striate-punctate, striæ not deeply impressed, punctures rather large, more or less concealed. *Under surface* with dense concealed punctures. Mesosternal receptacle slightly transverse. Each of the *femora* with a large acute tooth. Length $3\frac{2}{3}$, rostrum $1\frac{1}{4}$; width 2(vix)mm.; variation in length $3\frac{1}{4}$-$3\frac{2}{3}$ mm.

Hab.—Q.: Cairns(Macleay Museum).

The colour of the derm, owing to density of scales, cannot be seen; I have, however, scraped a few scales from the flanks of the prothorax; in ♀ the derm is there seen to be red, and in ♂ dark brownish-red. On ♂ the scales of the upper surface and legs are almost entirely of a dark brown colour; the fascicles, though not larger than in ♀, are better defined.

Tychreus furvus, n.sp.

♂. Short, with a somewhat angular outline. Dark chocolate-brown; rostrum almost black; antennæ (club excepted) and tarsi dull red. Moderately densely clothed with dark chocolate-brown scales with a few paler scales scattered about on the upper surface; the under surface (except three apical segments) and base of femora with pale scales, having an obscure pinkish tinge. Prothorax with six fascicles; elytra with fascicles extending across several interstices, one near base on 3rd-5th, one at summit of posterior declivity extending across suture from 5th to 5th, and a few feeble ones below it.

Rostrum slightly stouter than usual, sides feebly incurved to middle; moderately strongly punctate. Antennæ rather stouter than usual; scape inserted nearer apex than base of rostrum, slightly shorter than funicle; club shorter than two basal joints of funicle. *Prothorax* moderately transverse, apex subtubular; scarcely tuberculate beneath fascicles; densely and strongly punctate, punctures mostly exposed. *Elytra* once and one-third wider than prothorax; shoulders rounded, sides parallel to apical third, apex almost conjointly rounded; subtuberculate beneath fascicles; striate-punctate, striæ feeble, punctures moderately large, not approximate; interstices (except at fascicles) flat, considerably wider than punctures. Under surface moderately strongly punctate. Mesosternal receptacle strongly transverse, walls not thin. Posterior *femora* strongly, the others rather feebly dentate. Length 5, rostrum $1\frac{1}{6}$; width $2\frac{1}{6}$ mm.

Hab.—W.A.: Swan River.

The shape of the mesosternal receptacle is very different from that of *T. camelus* or *T. sellatus*, and would, perhaps, almost justify the erection of a new genus; the antennal club is unusually short. Owing to the loose nature of the scales (especially on the prothorax), the punctures can be distinctly seen without abrasion. The elytral fascicles are of an unusual character, appearing more like transverse dark velvety patches than the elongate fascicles of normal forms.

TYCHREUS SELLATUS Pasc.; *l.c.*, No.5523.

Elliptic-ovate, convex. Chocolate-brown; rostrum darker, base of scape red. Densely clothed with large soft ochreous-grey scales, almost uniform in colour throughout, except for a very distinct obovate patch of brown scales about the scutellum: partly on the prothorax but mostly on the elytra. Prothorax with six fascicles, of which the four median ones are feeble and the two apical scarcely traceable; elytra with semierect patches in feeble clusters but scarcely forming fascicles.

Head convex, very slightly flattened between eyes. Sides of rostrum moderately incurved, base moderately strongly punctate. Scape inserted slightly nearer apex than base, slightly shorter than funicle. *Prothorax* almost as long as wide; sides rounded, apex about half the width of base; densely punctate, punctures strong, round, deep, more or less concealed; with a feeble median carina moderately distinct in middle but feeble towards base, and absent at apex. *Elytra* not much wider than prothorax; shoulders rounded, apex almost conjointly rounded; striate-punctate, punctures rather large, more or less concealed; alternate interstices irregularly raised and subtuberculate in places. *Under surface* densely punctate. Mesosternal receptacle longitudinal. *Femora* strongly but not acutely dentate. Length $8\frac{1}{2}$, rostrum 2; width $4\frac{1}{4}$; variation in length $5\frac{1}{2}$-$8\frac{1}{2}$ mm.

Hab.—N.S.W.: Rope's Creek, Blue Mountains—Queensland.

The dark patch of scales about the scutellum is very distinctive. On removing the scales the head is seen to be densely but not very coarsely punctate, and to be entirely without ocular fovea.

TYCHREUS DILATICOLLIS Lea, Mém. Soc. Ent. Belge, xvi. 1908, p.182.

Hab.—New South Wales.

TYCHREUS CORYSSOMERUS Lea, *l.c.*, p.181.

Hab.—Queensland—New South Wales.

TYCHREUS REVERSUS, n.sp.

Convex, elliptic-ovate. Reddish; rostrum darker, antennæ (club excepted) paler than elsewhere. Densely clothed with pale fawn-coloured scales, but nowhere fasciculate, scales here and there darker; the prothorax with a dark subquadrate basal patch.

Rostrum coarsely punctured at basal third in ♂, at extreme base only in ♀. Scape scarcely half the length of funicle and club combined; in ♂ inserted slightly closer to base than apex, in ♀ inserted decidedly closer to base. *Prothorax* moderately transverse, apex less suddenly narrowed than usual; densely punctate, punctures round and strong, usually concealed. *Elytra* about once and one-third the width of prothorax, shoulders rounded, apex almost conjointly rounded; striate-punctate, punctures large, round, more or less concealed; interstices regular, gently convex, the width of punctures. *Under surface* densely punctate. Mesosternal receptacle decidedly longitudinal. *Femora* acutely dentate, teeth rather large. Length $3\frac{1}{4}$, rostrum 1; width $1\frac{1}{2}$; variation in length $3\frac{1}{4}$-4 mm.

Hab.—Q.: Barron Falls(A. Koebele), Cairns(Macleay Museum).

The absence of fascicles, and the insertion of scape are very distinctive of this species. The rostrum is longer, and more highly polished in ♀ than in ♂. On one specimen there is a feeble transverse elytral fascia of dark scales at about one-third from the base, and several spots near the apex.

Sympiezoscelus, Mitrastethus, and Bepharus.

These three genera possess many, and some unusual features in common; indeed, it is questionable whether the three names should be retained; however, as the tibiæ of *Sympiezoscelus* are very different from those of *Mitrastethus* and *Bepharus*, and the insertion and length of the scape, and the shape of the elytra in *Bepharus* are different from those of the others, it is perhaps advisable to retain all three. To avoid repetition, the features they possess in common are here given.

Head convex, not concealed by prothorax; ocular fovea small and deep. *Eyes* small, coarsely faceted, distant. Two basal joints of *funicle* elongate, the others transverse. *Prothorax* flat or very feebly convex, subconical, sides rounded from near apex, apex produced, not half the width of base, base bisinuate, constriction rather feeble, ocular lobes obtuse. *Scutellum* small, rounded, distinct. *Elytra* closely applied to and on a level with prothorax, base trisinuate, shoulders slightly produced. *Pectoral canal* moderately wide and not deep, terminated slightly nearer anterior than intermediate coxæ. *Mesosternal receptacle* flat, base truncate, side somewhat emarginate and then oblique to apex, emargination semicircular; cavernous. *Metasternum* large, distinctly longer than basal segment of abdomen; episterna large. *Abdomen* large, sutures distinct; 1st segment about once and one-third the length of 2nd, intercoxal process rounded; 3rd and 4th large and flat, their combined length more than that of 2nd or apical, with very deep sutures. *Legs* moderately long; femora stout, edentate, not grooved except near apex; tarsi slightly shorter than tibiæ, narrow, 3rd joint almost as long as wide, deeply bilobed, lobes narrow, claw-joint elongate and with long thin setæ. Elliptic, depressed, punctate, non-tuberculate, winged.

SYMPIEZOSCELUS Waterhouse.

Trans. Ent. Soc. 1853, ii.(n.ser.) p.203; Proc. p.104: Lacordaire, Gen. Col. T.vii. p.139.

Rostrum comparatively short and stout, curved only at base. *Antennæ* stout, scape short and stout, inserted nearer base than apex of rostrum, much shorter than funicle; club short, ovate, free. *Prothorax* as long as wide. *Elytra* very slightly wider than prothorax, sides subparallel to near apex, apex rounded. Intercoxal process of abdomen rather narrow. *Femora* very stout; tibiæ curved, in addition to the (rather strong) terminal hook with a small subapical tooth, strongly ridged above, the ridge of the posterior terminating in an acute tooth, of the anterior in an obtuse one.

SYMPIEZOSCELUS SPENCEI Waterh., Trans. Ent. Soc. 1853, p.203; Proc. p.104.

Reddish-castaneous or piceous-brown, shining. Head, prothorax, and elytra with a few stramineous scales scattered about in small spots; scutellum entirely clothed. Under surface and legs sparsely clothed, the mesosternal receptacle, four anterior coxæ and tibiæ more densely so than elsewhere.

Head sparsely punctate; ocular fovea small, deep, longitudinal. Rostrum shorter than prothorax, very feebly decreasing in width from near base to apex, a groove on each side from base to antennæ and another from antennæ to near apex; sparsely and moderately strongly punctate towards base, very finely towards apex. Scape stout, inserted at basal third of rostrum, terminated considerably before apex; 1st joint of funicle once and one-half the length of 2nd. *Prothorax* slightly convex; sparsely and finely punctate, punctures larger in middle than at sides. *Elytra* striate-punctate; punctures moderately large and round; interstices convex, regular, wider than punctures, impunctate. *Under* *surface* rather sparsely and shallowly punctate, each puncture carrying a scale. *Femora* very stout, scarcely twice as long as wide, compressed, feebly punctate; tibiæ rather strongly punctate, beneath seriate-punctate, the series separated by narrow ridges. Length $7\frac{1}{2}$, rostrum $1\frac{1}{2}$; width $3\frac{1}{4}$ mm.

Hab.—Queensland—Northern coastal rivers of New South Wales.

In the Transactions (*supra*) Mr. Waterhouse says that he was not sure whether his specimens were from Australia or New Zealand; but, in the Proceedings, the habitat is given as Richmond River. Mr. Pascoe says that the species is "without doubt" from Queensland. There are specimens from the Clarence River in the Macleay Museum.

MITRASTETHUS Redtenbacher.

Reise der Novara, ii. p.167; Broun, Man. New Zealand Col. p.504.

Rostrum comparatively short and stout, slightly curved at base. *Antennæ* stout; scape short and stout, inserted nearer base than apex of rostrum, much shorter than funicle; club short, ovate, free. *Prothorax* slightly transverse. *Elytra* very slightly wider than prothorax, sides subparallel to near apex, apex rounded. Intercoxal process of *abdomen* moderately wide. *Tibiæ* compressed, curved, in addition to the (rather strong) terminal hook with a small subapical tooth, and above with a small acute one, which is sometimes obscured by scales.

M. Lacordaire places both *Chætectetorus* and *Sympiezoscelus* in his fourth "groupe," the former in the *Cryptorhynchides vrais*, the latter in the *Sympiezoscelides*, the two being distinguished by the shape of the femora. Both, however, agree in having the metathoracic episterna very large, in which respect they differ from the *Tylodides*. Without seeing *Mitrastethus* (unknown to Lacordaire), I would probably have considered the two divisions necessary, but this genus leaves no doubt in my mind but that it, together with *Sympiezoscelus* and *Bepharus*, belong to the *Chætectetorus*-group, the three genera being so closely allied that it would be ridiculous to separate them. Of *Mitrastethus* I know two species: *M. baridioides*, from New Zealand, and *M. australiæ* from Queensland and New South Wales. In shape both strongly resemble *Metacymia*, have the long claw-joint, and small and coarsely faceted eyes of most of the allies of *Chætectetorus*, and the large metasternum of *Pseudapries*, with, to a certain extent, the large abdominal punctures of that genus; and the subapical tooth to the tibiæ as in *Euthyrrhinus*; and, although the femora are not so stout as those of *Sympiezoscelus*, they are equally as stout as those of *Bepharus*.

MITRASTETHUS AUSTRALIÆ Lea, Mém. Soc. Ent. Belge, xvi. 1908, p.177.

Hab.—Queensland, and northern coastal rivers of New South Wales.

BEPHARUS Pascoe, Trans. Ent. Soc. 1870, p.207.

Rostrum moderately long and rather thin, moderately curved throughout. *Antennæ* thin; scape inserted distinctly nearer apex than base of rostrum, slightly shorter than funicle; club ovate, free. *Prothorax* slightly transverse. *Elytra* subcordate, slightly wider than prothorax at base, widest before middle, apex produced and flattened, each inwardly oblique to suture. Intercoxal process of *abdomen* moderately wide. *Tibiæ* slightly compressed, almost straight, without subapical tooth, the terminal hook rather feeble.

BEPHARUS ELLIPTICUS Pasc.; Mast. Cat., Sp. No.5572.

Bright reddish-castaneous, highly polished. Tibiæ, apex of elytra, flanks of prosternum and sides at base of rostrum feebly squamose, elsewhere glabrous.

Head impunctate, transversely and narrowly impressed between eyes. Rostrum the length of prothorax, parallel-sided from behind antennæ to apex, a groove on each side from base to antennæ; impunctate. Scape inserted at apical two-fifths of rostrum, passing apex; 1st joint of funicle twice the length of 2nd. *Prothorax* very slightly convex; feebly punctate towards apex, disc with three large and very distinct punctures, elsewhere impunctate. *Scutellum* smooth, impunctate. *Elytra* punctate-striate, the striæ moderately deep near suture, becoming very feeble towards sides; punctures moderately large, somewhat rounded, not very close together, smaller at sides than about middle, entirely absent on flattened apical portion. *Under surface* impunctate except on metasternal episterna, intercoxal process of abdomen, and sutures of the third and fourth segments. *Femora* stout; tibiæ seriate-punctate, each puncture carrying a scale. Length $3\frac{2}{3}$, rostrum $\frac{4}{5}$; width $1\frac{2}{3}$ mm.

Hab.—Q.: Wide Bay.

A highly polished species, which should be easily recognised on account of the three large punctures or small foveæ on the prothorax, and the peculiar flattening of the apical portion of the elytra.

Genus EUTHYRRHINUS Schönherr.

Gen. et Spec. Curc., Vol.iv., Pt.i., p.271; Lacord., Gen. Col. vii. p.111.

Head round, vertex slightly flattened; ocular fovea indistinct. *Eyes* large, round, finely faceted, distant. *Rostrum* long, straight, subparallel, punctate. *Antennæ* rather short; scape short, inserted slightly before or slightly behind middle of rostrum and not extending to apex; two basal joints of funicle elongate, the rest transverse; club elliptic, ovate or briefly ovate, subsolid. *Prothorax* subtriangular, feebly or not at all overhanging head, base bisinuate. *Scutellum* small, round, raised, distinct. *Elytra* closely applied to prothorax, base trisinuate, shoulders slightly projecting, apex mucronate. *Pectoral canal* rather narrow, deep, terminated between anterior and intermediate coxæ. *Mesosternal receptacle* raised, open, transverse or longitudinal. *Metasternum* large; episterna wide. *Abdomen* with distinct sutures, two basal segments large or very large. *Legs* comparatively short; femora dentate, feebly grooved beneath, not extending to apical segment of abdomen; tibiæ thin, compressed, ridged beneath; in addition to the terminal hook (which is above the average size) with a small tooth immediately below insertion of tarsi and more distinct on anterior than on posterior pair; tarsi shorter than tibiæ, 1st joint long, 3rd wide, deeply bilobed, claw-joint long, squamose. Ovate or elliptic, granulate, punctate, squamose, winged.

Only two species are known from Australia, and these are so different in appearance that, at a glance, they might be supposed to belong to two distinct genera. The two tibial hooks, and the apical mucro of elytra are characters which are not found together in any other Australian genus of the subfamily.

Elliptic; prothorax with longitudinal fascicles, carinate and not granulate; elytra long; club short... *spinipennis* Wath.
Ovate; prothorax granulate, not fasciculate or carinate; elytra short; club long........................ *meditabundus* Fabr.

EUTHYRRHINUS MEDITABUNDUS Fabr.; Mast. Cat., Sp.No.5504.

Cryptorhynchus monachus Boisd.

♂. Ovate, convex. Black, subopaque; antennæ and claw-joints dull reddish-piceous. Head with obscure whitish scales filling punctures, base of vertex and sides near eyes with white scales, between eyes and base of rostrum with brown and white scales intermingled. Prothorax with white scales forming a short oblique patch on each side near apex, behind each stripe a patch of obscure ochreous scales, a spot of snowy scales on each side of middle, white scales margining scutellar lobe and muddy scales distributed elsewhere, flanks with snowy scales. Elytra with whitish scales distributed about suture, middle and sides near apex, and with brownish or ochreous scales irregularly dispersed. Under surface (including pectoral canal and mesosternal receptacle) and legs with dense, snowy, rounded scales closely adpressed to derm, and occasionally with a pale ochreous tinge.

Head densely punctate, feebly granulate. Rostrum long, straight, densely and rather coarsely punctate throughout; a feeble carina in middle terminating before base and apex. Antennæ short, rather thick; scape inserted almost in exact middle of rostrum, shorter than funicle; two basal joints of funicle elongate; club elongate, cylindric to near apex, subsolid.

Prothorax not overhanging head, subtriangular, disc slightly convex, apical fourth narrow, subtubular; densely and rather obsoletely punctate, numerous small granules on middle and apical portions of disc, base without granules. *Scutellum* round, raised, sloping downwards to prothorax. *Elytra* slightly wider than prothorax and not twice its length; base trisinuate, impinging on prothorax on each side of suture; shoulders slightly projecting forwards; ten rows of punctures on each elytron, punctures set in grooves, round, subapproximate, larger near base (especially near shoulders) than elsewhere; interstices usually wider than seriate punctures, finely punctate, rounded, the alternate ones slightly raised; suture more distinctly raised near scutellum than elsewhere, with small depressed granules; apex with a thin mucro. Anterior *legs* long; femoral teeth more noticeable than on four posterior; tibiæ thin, arcuate, strongly compressed; subapical tooth distinct (on four posterior they are not visible); posterior femora just passing 3rd abdominal segment. Length 8½, rostrum 2; width 4; range of variation 5¼-12 mm.

♀. Differs in having rostrum thinner, longer, base densely but not coarsely punctate, half the distance behind base rather sparsely punctate; apical half highly polished and scarcely punctate; scape thinner, insertion slightly nearer base than apex; prothorax broader; elytral interstices scarcely alternately raised, legs shorter, and apical mucro shorter.

Hab.—Eastern Australia(widely distributed). Also recorded from Lord Howe and Norfolk Islands, and New Guinea. I have obtained larvæ and imagines which were boring in citrous trees and various species of *Casuarina.*

This species is subject to very great variation in size, colour and density of scales, form, and sculpture. I have received specimens from the late Herr J. Faust under various MS. names. He sent me also a specimen labelled *E. brevispinis* Fairm. The male from which the above description was taken is rather small, but in good condition. The white scales on the upper surface of many specimens become yellow; the two small spots on prothorax are frequently absent; the scutellar lobe is usually but not always clothed with denser scales than elsewhere; in some specimens the whole of the prothoracic scales are of a uniformly muddy-ochreous colour; in others it is densely clothed with ochreous scales of various shades, from almost white to dark brown. The scales on the elytra are also subject to very great variation; they are occasionally rather dense and almost uniform in colour, sometimes obscuring the punctures, these appearing very small and in narrow grooves; in others they are uniformly muddy-brown, a transverse fascia of ochreous scales across the middle excepted; in two specimens the fascia is represented by a small spot on each side; on others the scales are almost uniformly sooty-black; others are irregularly mottled with black, sooty, ochreous, white and brown scales. The clothing of the under surface also varies considerably, both in colour and density, on many becoming ochreous, and on a number almost uniformly leaden or sooty; on a specimen lent to me by the late Herr Faust the two basal segments are densely clothed with snowy scales, except an obscure spot on the side of each; the scales on the three apical segments are tinged with ochreous, each of them with a small brown spot at the sides; there is also a large brown blotch common to the third and fourth; on this specimen also the legs are feebly ringed with ochreous, white, and brown scales. A specimen in the Australian Museum is densely and almost uniformly clothed on the upper surface with almost snowy-white scales. Perhaps the most noticeable difference in form is that of the prothorax; it has usually a somewhat triangular outline, but many specimens have the middle only a little narrower than the base. The prothoracic granules are usually massed together in a somewhat triangular space in the middle; occasionally there is a transverse patch of them near base; sometimes, but rarely, a few are on the sides. The scutellum varies slightly in length and width. The elytral punctures appear to be different in size on different specimens, but this is more apparent than real, and is caused principally by the comparative density of the clothing; the suture is often granulate to summit of posterior declivity; sometimes the granules scarcely extend to basal half; occasionally they are not at all depressed; the 3rd interstice and shoulder are sometimes granulate, sometimes a few reddish granules are placed near apex; several specimens have the elytra tinged with red; the small apical mucro varies in length and thickness. Several females have a feeble impression on the rostrum between bases of antennæ.

EUTHYRRHINUS SPINIPENNIS Waterh.; Mast. Cat., Sp.No.5513.

Chætectetorus spinipennis Waterh.; *Euthyrrhinus navicularis* Pasc.

♂. Elliptic, convex, angular. Black, subopaque; base of scape, basal joints of funicle, and claw-joints dull red. Head with brown and ochreous scales intermingled, on basal sides of rostrum becoming almost white. Prothorax with black, blue-black, brown, and ochreous scales intermingled; each side of apex with a fascicle of black scales, these continued behind and gradually widening to about the middle, also continued on the sides but to a less distance, sometimes all continued to base and appearing as four longitudinal stripes; flanks with patches of ochreous intermingled with black scales. Elytra with patches of dark ochreous scales, intermingled with others of a blue-black colour, small subfasciculate patches of black scales irregularly dispersed; each elytron with two moderately distinct patches, one at about one-fourth from base, and one about middle; each side of posterior declivity with a distinct tuft of ochreous scales. Undersurface with soft scales of greyish and blackish colours: longer on metasternum, coxæ, base of femora and mesosternal receptacle, than elsewhere; ochreous scales on each side of pectoral canal, anterior coxæ, sides of sterna, and to a less extent on sides of abdomen, walls of pectoral canal with sparse whitish scales; legs with whitish scales.

Head densely punctate, vertex convex. Rostrum long, flattened, straight, widening to base and to a less extent to apex; densely and moderately roughly punctate, punctures suboblong, smaller near apex than near base; a feeble median carina or impunctate line continued from base almost to extreme apex.

Scape inserted in exact middle of rostrum, not quite reaching apex; two basal joints of funicle elongate, 1st as long as 2nd-3rd, 2nd not as long as 3rd-4th, 7th rather large, subadnate to club; club short, but on account of 7th funicular joint appearing elongate. *Prothorax* subtriangular, sides slightly rounded; disc feebly convex and with a feeble median carina not extending to base or apex; densely and regularly punctate, punctures small. *Scutellum* small, raised, rounded, somewhat irregular. *Elytra* slightly wider than prothorax and more than twice its length, sides decreasing in almost perfectly straight lines from base to near apex, apex with a small sharp mucro; base trisinuate, on each side of suture and the shoulders feebly impinging on prothorax; punctate-striate, punctures feeble and much obscured by scales, interstices rounded, wider than punctures, regular; suture slightly raised and granulate, granules reddish. *Undersurface* densely and regularly punctate. Anterior and posterior *legs* moderately long; posterior femora slightly passing 3rd abdominal segment, teeth of anterior sharper than those of posterior, which are obtuse; subapical teeth of anterior tibiæ small but moderately distinct, on posterior they are very small. Length $11\frac{1}{2}$, rostrum 3; width $4\frac{5}{8}$; variation in length $5\frac{1}{2}$-$12\frac{1}{2}$ mm.

♀. Differs in having the rostrum thinner, shining, less coarsely punctate and without median line; scape inserted slightly nearer base than apex, and not extending as far as in ♂; the club is a little shorter and thinner, and the body is slightly more robust.

Hab.—South-west Australia.

EUTHYRRHINUS SPINIPENNIS, Waterh., var. ORIENTALIS, n.var.

A specimen from Port Phillip (Berlin Museum), and another from the Victorian Alps (Rev. T. Blackburn), agree in all structural details with *E. spinipennis*, but have very different clothing. The prothorax and elytra are entirely without the characteristic blue-black scales; the prothorax has the elongate median fascicles of a brown colour, and rather less distinct; the scales elsewhere are brown and ochreous; towards the sides there are numerous white scales. On the elytra the scales are somewhat similar to those of the prothorax, but the disc on each side is marked by a large subtriangular patch of velvety scales; each patch is bounded posteriorly by white scales, and there are a few whitish ones before it. The under surface and legs are clothed with ochreous, intermingled with snowy, scales.

Genus ODOSYLLIS, Pasc., Journ. Linn. Soc. Zool. xii., p.40.

This genus appears to be numerously represented in the Malay Archipelago, but hitherto one species only has been recorded from Australia. In his original description of the genus, Pascoe compares it with *Nedymora*, not even mentioning *Euthyrrhinus*, to which (at any rate *O. crucigera*) it is remarkably close,* differing chiefly by the mesosternal receptacle being slightly cavernous instead of open. As I am acquainted with only one species† of the genus, I have not ventured to give its generic characters. I have described the species at length, however, as the original description is somewhat faulty.

ODOSYLLIS CRUCIGERA Pasc.; Mast. Cat., Sp.No.5503.

♂. Black, antennæ and claws of a very dingy red. Densely clothed with soft pale brown scales, in some places varying almost to white, and in others almost to black.

Head with fairly dense but more or less concealed punctures. Rostrum apparently slightly longer than prothorax, curved, and rather thin; base considerably wider than apex, sides incurved to middle; with coarse and irregular punctures on basal third, very fine elsewhere. Antennæ rather thin, inserted about two-fifths from apex of rostrum; two basal joints of funicle elongate, the second distinctly longer than the first. *Prothorax* transverse, base strongly bisinuate, sides strongly rounded, apex subtubular; middle of base distinctly impressed; punctures entirely concealed; with rather large shining unisetose granules. *Scutellum* trans-

† For three cotypes of *O. crucigera*, I am indebted to Dr. R. Gestro.

* The figure of the typical species, *O. congesta* (Plate i., fig.5) is also much like that of a Euthyrrhinus.

versely impressed about the middle, raised on each side of base. *Elytra* trisinuate at base, not much wider than prothorax, widest near base, thence rapidly diminishing in width to apex, which is mucronate, striate-punctate, punctures large, round, more or less concealed; interstices each with a series of shining and rather large granules, becoming smaller posteriorly. *Mesosternal receptacle* briefly U-shaped, slightly cavernous. Basal segment of *abdomen* almost the length of three following ones combined, its apex raised in middle, apical segment depressed at apex. *Legs* rather long; femora moderately stout, the front pair strongly and acutely dentate, the others each with a very minute and usually concealed tooth; tibiæ curved on their outer edge, the front pair bisinuate on the lower edge, front sinus longer than the hind one and clothed with dense reddish hair. Length 11-13 mm.

♀. Differs in having the rostrum thinner, antennæ inserted in middle of sides of rostrum, front tibiæ shorter, not bisinuate, and without dense reddish hair.

Hab.—North Queensland. Also occurs in New Guinea.

On the basal half of the elytra the scales are mostly of a pale brown colour, mottled with small sooty patches which become rather numerous and then suddenly terminate in a zigzag manner at the middle; the apical half, except for a narrow smoky V, is almost uniformly clothed with very pale scales. The V commences at the apex, and extends about half-way to the middle, but its tops do not pass the third interstice, although they are sometimes very feebly connected with an indistinct spot on the very feeble preapical callosities. On the prothorax there are usually three pale longitudinal stripes, distinct on the apical half, but disappearing before the base, and rather feebly connected across the middle. On the elytra a few stout setæ are scattered about. The clothing of the under surface is of a peculiarly soft character, most of the scales being heart-shaped and closely applied to the derm, entirely concealing the punctures in which they are set. The femora are very feebly ringed. The granules on the prothorax have each a seta directed forwards, whilst those on the elytra are directed backwards.

In outline it is like *Euthyrrhinus meditabundus.*

Var. FUSCOTRIANGULARIS, n. var.

Two specimens (sexes) from the Mossman River differ from the typical form in having the granules much smaller, those on the disc of the prothorax and apical half of the elytra almost or quite concealed; the clothing less variegated, on the prothorax scarcely forming longitudinal stripes, although a feeble transverse one can be traced; on the elytra there are fewer blackish scales, but there is a large indistinct brownish triangle extending from the third interstice (which is rather more noticeably raised than in the typical form) to the shoulder and margin, and terminating at the middle on each side; the paler scales (which, however, are not very pale) on the three sutural interstices are, therefore, not interrupted at the middle, but extend almost to the base. The suture, and almost the whole length of the posterior declivity, are clothed with black scales, without the least trace of a V; and there is a small elongate blackish spot on each of the preapical callosities. The abdomen is almost entirely clothed with black scales; in the typical form the darker scales are usually confined to the middle of the third and fourth segments.

I have described these two specimens as representing a variety, rather than a distinct species, as the dentition of the femora, the peculiar front tibiæ of the male, and the structural characters (other than the granules) are exactly as in the typical form.

Genus GASTEROCERCUS Lap. et Br.

I have seen no Australian species of this genus.

GASTEROCERCUS NIGROÆNEUS, Chevr.; Mast. Cat., Sp.No.5535.

Doubtfully referred to the genus by M. Chevrolat.

Hab.—Queensland.

THE BIRDS OF LORD HOWE AND NORFOLK ISLANDS.

By A. F. Basset Hull, Sydney.

The literature relative to the birds of Lord Howe and Norfolk Islands is by no means voluminous, and is at the same time so scattered that no little research is required to arrive at a knowledge of what has already been chronicled.

In his 'Handbook of the Birds of Australia,'(Vol.ii., Appendix, pp.526-550: 1864) Gould described four species from Norfolk Island; one (the extinct *Nestor productus*) from Phillip Island; and three from Lord Howe Island, all of which had been figured in the folio edition.

In his 'Tabular List of the Birds of Australia'(1888), Ramsay enumerated 28 species for Lord Howe Island, 14 for Norfolk Island, and 14 common to both islands. Many of these species, however, especially those recorded from Lord Howe Island, are merely casual visitors.

The principal descriptive articles relative to the nests and eggs of the birds found breeding on these islands are the following:—

(1) Crowfoot, W. M., M.D.—"Notes on the Breeding Habits of certain Sea-birds frequenting Norfolk Island, and the adjoining Islets." Ibis, iii., 5th ser., p.263, 1885.

(2) North, A. J.—"Nests and Eggs of Birds found breeding on Lord Howe and Norfolk Islands." Aust. Mus. Cat. No.12, Appendix, p.372 and p.407, 1899. [Two separate articles.]

(3) North, A. J.—"Notes on the Oology of Lord Howe Island." Aust. Mus. Memoirs, No.2, Lord Howe Island, 1889.

The first of these articles is based entirely upon information furnished to Dr. Crowfoot by Dr. P. H. Metcalfe, Resident Medical Officer at Norfolk Island, to whom also North acknowledges his indebtedness for the bulk of the information relative to the land-birds of Norfolk Island contained in his several papers. The particulars relative to the Lord Howe birds were for the most part furnished by Messrs. R. Etheridge, J. A Thorpe, and T. Whitelegge, who paid a visit of investigation to that island in 1887, on behalf of the Trustees of the Australian Museum.

In his work on the 'Nests and Eggs of the Birds of Australia,' published in 1901, A. J. Campbell makes occasional reference to the Lord Howe or Norfolk Island habitat of certain species common to the mainland also.

In the Proceedings of the Linnean Society of New South Wales (Vol. ii., 2nd series, p.678, 1887), Dr. Ramsay described the eggs of three species of sea-birds from "Lord Howe's Island," viz.: *Sterna (Onychoprion) fuliginosa*, *Procelsterna (Anous) cinerea*, and *Sula cyanops*.

There is also an interesting paper by Dr. Ramsay entitled "Notes on the Zoology of Lord Howe's Island" (Proc. Linn. Soc. N. S. Wales, Vol. vii., p.86, 1882). This paper is principally devoted to the avifauna, and a Table of the birds found on the island is appended, showing the occurrence of the same genera or species in New Zealand and New South Wales respectively.

There are other descriptions of, or references to, the birds found in these islands and their eggs, scattered through the files of the Ibis, Proceedings of the Zoological Society (Lond.), Proceedings of the Linnean Society of New South Wales, the British Museum Catalogue of Birds' Eggs, and other scientific publications. There is a paper on the Birds of Norfolk Island by Herr A. von Pelzeln (Sitzungsber. Wien. Akad. xli. 1860, pp.319-332), no copy of which is obtainable in Sydney.

In the following pages, references are given to most of the publications where mention is made of the occurrence, at the Lord Howe or Norfolk Island Groups, of species not peculiar to those groups. Of the peculiar species references are given to the most important articles, descriptive of the birds or their eggs, but these references do not pretend to be in any way complete.

For the sake of brevity, references to the principal articles are given hereafter as follows—Gould; Crowfoot; Ramsay; North, 'Nests and Eggs'; North, 'Lord Howe Island'; Etheridge, 'Lord Howe Island'; Campbell.

It has been my good fortune to spend a few weeks on these Islands. In 1907 I visited Lord Howe Island, remaining there from the 3rd to the 17th of October; and in 1908 I spent from the 8th of October until the 15th of November at Norfolk Island. My primary object was to see the immense flocks of Terns, Noddies, and other sea-birds during the breeding season, but at the same time I was enabled to glean some information and to make personal observations as to the land-birds.

Lord Howe Island is situated in lat. 31° 33′ S., and long. 159° 5′ E. It is about 450 miles north-east of Sydney, and 300 miles from Port Macquarie, the nearest point of the continent of Australia in a direct line. It is nearly seven miles in length, and about one mile in average width. It is crescent-shaped, the two horns or points being connected by a coral-reef enclosing an extensive and shallow lagoon. The superficial area of the Island is about 3,220 acres. The group consists of Lord Howe Island proper, a small islet immediately detached from its southern extremity, called Gower Island; a similar one to the north known as the Sugar Loaf; to the east, separated by somewhat more than half a mile of water, another, named Mutton Bird Island; whilst on the western side, within the Lagoon, is Goat Island. To the north-east of the main Island, from a quarter of a mile to nearly a mile distant, is a cluster of six rocky islets, known as the Admiralty Islets. Still further north lie two other rocks, one being called North Island. About 18 miles to the south, the extraordinary steeple-rock, called Ball's Pyramid, towers to a height of 1,800 feet from the ocean. It is quite inaccessible to human beings, but is the haunt of numerous sea-birds.

The main Island consists of three groups of basaltic hills, connected by two sandy flats covered with dense vegetation. The southernmost group contains Mt. Gower, 2,840 feet, and Mt. Lidgbird, 2,500 feet. The former shows a bold face or precipice almost sheer from the top to the sea, and is visible in clear weather from a distance of 80 miles.

The whole Island, excepting the small settled area, is well covered with Kentia Palms, Banyans, and other trees, and in many places the undergrowth and tangled vines make progress through the bush difficult and at times impossible.

Norfolk Island is situated in lat. 29° 3′ S., and long. 167° 38′ E., and is about 950 miles from Sydney. The group consists of Norfolk Island, about 4½ miles in length by 5 miles in breadth, irregularly square-shaped. Nepean Island, a flat-topped rocky islet, lies a quarter of a mile to the south-east; Phillip Island, about a mile and a half in length by three-quarters of a mile in breadth, lies three miles to the southward. There are twelve small rocky islets to the north, and some scattered rocks to the south of Norfolk Island.

The coast-line of Norfolk Island is bold and steep, rising sharply from 100 to 300 feet, except at the three practicable landing-places, Kingston, Cascade, and Ball Bay. Even at these places the steep hills rise very close to the shore. The whole Island is of basaltic formation, consisting of a succession of rounded hills with deep gullies between, and in the north-western corner Mount Pitt rises to an altitude of 1,044 feet. From the "mountain" and the coastal hills very deep gullies, densely wooded, run down to the coast, in many instances terminating in a sheer cliff descending to the sea. Those at the back of Mt. Pitt, descending to Anson Bay and Duncombe Bay, are the steepest and most heavily timbered, huge pines (*Araucaria excelsa*), white oaks (*Lagunaria Patersoni*), ironwoods (*Notelæa longifolia*), and bloodwoods (*Baloghia lucida*), grow so close together that their spreading branches become interwoven, forming deep shade in which the rank undergrowth flourishes. Tangled vines, as thick as a man's arm, depend from the branches, and lie twisted along the ground. Fortunately, there are excellent roads forming a perfect network over the whole Island, and many tracks have been cut through the timber to give access to the various surveyed blocks, but the growth of the vegetation is so rapid that unless regularly cleared the tracks soon become obliterated.

A glance at the chart compiled by Chas. Hedley, of the Australian Museum,* shows that Lord Howe Island lies on the extreme south-west, and Norfolk Island on the eastern extremity of the " Limit of Continental Area," and the route of migration of fauna from Antarctica is shown as passing through New Zealand and Norfolk Island, with a lateral branch to Lord Howe Island. So far as regards the avifauna breeding on the two last-mentioned islands, of 42 species, 11 are Australian, 2 are New Zealand, and 9 are common to both; the remaining 20 species being peculiar. Only two birds are found breeding in common in New Zealand and both Islands under review, viz., *Halcyon vagans* and *Hypotænidia philippinensis*. *Porzana plumbea* and *Porphyrio melanonotus* breed both in New Zealand and Norfolk Island, while the latter species is recorded as a casual visitor to Lord Howe Island. There is, moreover, a marked similarity between the species peculiar to each of the two Island groups; one species (*Aplonis fuscus*), not found elsewhere, is common to both; and, in general, it may be said that the whole avifauna of these islands is more distinctly Australian in character, although the Wood Hen (*Ocydromus sylvestris*) and the extinct *Notornis alba* and *Nestor productus* may be regarded as of greater value in determining the original route of emigration.

In the following pages I have endeavoured to give a complete list of all the birds recorded or observed as breeding in or visiting these island-groups. The habitat is given for either or both islands, as the case may be, and the species not known to have bred at any time in the locality are described as "visitors only." The habitat outside the groups under review is given in brackets, the particulars being taken from Gregory Mathews' 'Hand-List.' The species are arranged in the same order, and numbered as in the Hand-List. The authors' vernacular names are given,

* Hedley, C., "A Zoogeographic Scheme for the Mid-Pacific." Proc. Linn. Soc. N. S. Wales, 1899, p.391.

followed by the local vernacular names which, it will be noted, frequently differ in regard to the same species in each island.

The dimensions of eggs are given in inches and 100ths, and, unless otherwise stated, are from specimens measured by myself.

The following table shows all the species which, to the best of my knowledge, actually breed on these Islands:—

Table of Species.

Genus.	Species.		See Note.
	Lord Howe Island.	Norfolk Island.	
Chalcophaps	*chrysochlora*	*chrysochlora*	A.
Hypotænidia	*philippinensis*	*philippinensis*	A., N.Z.
Porzana	——	*plumbea*	A., N.Z.
Porphyrio	——	*melanonotus*	A., N.Z.
Ocydromus	*sylvestris*	——	P.
Puffinus	*chlororhynchus*	*chlororhynchus*	A.
,,	——	*assimilis*	A.
,,	——	*griseus*	A,, N.Z.
,,	*tenuirostris*	——	A., N.Z.
Œstrelata	*neglecta*(?)	*neglecta*(?)	A., N.Z.
Sterna	*fuliginosa*	*fuliginosa*	A.
Procelsterna	*cinerea*	*cinerea*	A., N.Z.
Anous	*stolidus*	*stolidus*	A.
Micranous	——	*leucocapillus*	A.
Gygis	——	*alba*	A.
Anas	——	*superciliosa*	A., N.Z.
Sula	*cyanops*	*cyanops*	A.
Phaëthon	*erubescens*	*erubescens*	P.
Ninox	*albaria* P.	*boobook*	A.
Platycercus	——	*elegans*	A.
Cyanorhamphus	——	*cooki*	P.
Halcyon	*vagans*	*vagans*	N.Z.
Chalcococcyx	——	*lucidus*	A., N.Z.
Petrœca	——	*multicolor*	P.
Gerygone	*thorpei*	——	P.
Pseudogerygone	*insularis*	*modesta*	P.
Rhipidura	*macgillivrayi*	*pelzelni*	P.
Diaphoropterus	——	*leucopygius*	P.
Merula	*vinotincta*	*fuliginosa*	P.
Pachycephala	*contempta*	*xanthoprocta*	P.
Zosterops	*tephropleura*	*tenuirostris*	P.
,,	*strenua*	*albigularis*	P.
,,	——	*cærulescens*	A., N.Z.
Aplonis	*fuscus*	*fuscus*	P.
Strepera	*graculina*	——	A.

Note.—A.=Australian species. N.Z.=New Zealand species.
P.=Peculiar to the Island.

COLUMBIFORMES.

30*a*(M). 1. Hemiphaga spadicea Latham.

Hab.—Norfolk Island (extinct).

For figure and references, see Rothschild's "Extinct Birds," p.161, pl.xxi., 1907.

36(M). 2. Chalcophaps chrysochlora Gould.

Little Green Pigeon; Pigeon (Lord Howe Island); Dove (Norfolk Island).

Chalcophaps chrysochlora, Ramsay, p.38; North, 'Nests and Eggs,' p.373; North, 'Lord Howe Island,' p.45; Etheridge, 'Lord Howe Island,' p.10; Campbell, p.679.

Hab.—Lord Howe and Norfolk Islands. (Northern and Eastern Australia, Molucca Is., New Hebrides, Solomon Is.).

The beautiful Little Green Pigeon is very plentiful in both Islands; and is so tame, at Lord Howe Island, that it can easily be snared by a noose at the end of a stick. At Norfolk Island it is protected against indiscriminate destruction, exception being made in favour of invalids who may require some such delicate morsel as a roasted pigeon to tempt the appetite!

Its nest is generally placed amongst vines, or on the horizontal branch of a tree from five to ten feet from the ground. It is constructed of the spiral tendrils of dead vines and thin twigs, forming a slight platform, through the interstices of which the creamy-white eggs can be plainly seen from beneath.

At Lord Howe Island I found a nest on the 5th of October, 1907, containing two highly incubated eggs; and on the 18th of the same month, I found two nests containing young birds about a week old. Fresh eggs were found at Norfolk Island in October and November, 1908, but the general breeding season appears to be during August and September.

Archdeacon Comins informed me that this pigeon is not indigenous to Norfolk Island, but was introduced from the Solomon Islands, some years ago, by the late Archdeacon Palmer of the Melanesian Mission. From the fact that it is common to

Australia, Lord Howe, and the New Hebrides Islands, one would naturally expect to find it at Norfolk Island.

One of the most charming sights in these beautiful islands is a pair of these pigeons walking tamely about under the palms and tree-ferns, or taking short flights amongst the low branches, the sun glinting from the bronze-green plumage as the birds turn sharply in their erratic flight.

The call of this bird is an oft-repeated and somewhat monotonous "Coo-coo." A solitary bird will sit amongst the dense foliage of a large forest-tree, with its breast resting on a branch, emitting its cry at frequent intervals for an hour or more. Dimensions of eggs: (1) 1·05 × 0·8(L.H.I., 5th Oct., 1907); (2) *a*, 1·1 × 0·9; *b*, 1·04 × 0·84(N.I., 25th Dec., 1908).

38(M). 3. PHAPS ELEGANS Temminck.

Brush Bronze-wing Pigeon.

Hab.—Lord Howe Island(accidental). (Australia generally, Tasmania).

A single specimen arrived at Lord Howe Island early in 1907, in a very exhausted condition. It was captured by Mrs. Nichols, who had it in captivity when I visited the island in October, 1907.

RALLIFORMES.

49(M). 4. HYPOTÆNIDIA PHILIPPINENSIS Linnæus.

Pectoral Rail; Rail(L.H.I.); Little Tarler Bird(N.I.).

Hypotænidia philippensis Ramsay, p.38; Etheridge, 'Lord Howe Island,' p.11; Campbell, p.740.

Hab.—Lord Howe and Norfolk Islands. (Australia generally, Tasmania, New Zealand, Malay Archipelago, &c.).

This Land Rail is found on both islands, although it is stated (Etheridge, L.H.I., p.11) to have been introduced into Lord Howe Island. Mrs. Nichols, a very old resident, informed me that it was introduced by the late T. R. Icely when Visiting Magistrate there.

It frequents a few reedy patches in the settled part of the Island. I saw only a single bird during my visit; but was informed by Mr. J. B. Waterhouse that it bred there.

At Norfolk Island it is found in the Taro patches growing in the creeks and in the vicinity of the Mission dam. A clutch of eight eggs, forwarded to me by a young collector who took them on the 5th December, 1908, are of the usual type, but of a rather reddish-yellow ground, owing doubtless to the red soil. Dimensions: (*a*), 1·56 × 1·16; (*b*), 1·50 × 1·16; (*c*), 1·49 × 1·16; (*d*) 1·46 × 1·16; (*e-f*), 1·45 × 1·14; (*g*) 1·4 × 1·12; (*h*) 1·4 × 1·11.

52*a*(M). 5. OCYDROMUS SYLVESTRIS Sclater.

Rufous-winged Moorhen; Wood Hen (L.H.I.).

Ocydromus sylvestris Sclater, P.Z.S. 1869, p. 472; North, 'Nests and Eggs,' p. 414; Etheridge, 'Lord Howe Island,' p. 13; North, Rec. Aust. Mus. i., p. 37 (1890).

Hab.—Lord Howe Island.

It was not my good fortune to see any specimens of this bird, which is so closely allied to the New Zealand Weka. Its habitat is amongst the rugged and almost inaccessible parts of Lord Howe Island. North says*:—"Here the rough character of the country, consisting of huge boulders of granite [? basalt] almost hidden in a dense and luxuriant mass of subtropical vegetation, affords it a secure retreat." A nest found in October, 1889, 'at the head of the Erskine Valley" (a high ridge connecting Mount Lidgbird with Mount Gower) "consisted merely of a depression in a thick débris of fallen leaves, under the shelter of a low bush. The eggs, four in number, vary in shape from ovals to lengthened ovals, being slightly pointed at one end, and are of a dull white, with minute dots and large irregular shaped markings of light chestnut-red more or less scattered over the surface of the shell, obsolete markings of the same colour predominating towards the larger end. They are not unlike very large specimens of *Hypotænidia philippensis*, . . . but the markings are paler and

* Nests and Eggs, p. 414.

not so well defined.* Length (A) 1·9 × 1·32; (B) 1·88 × 1·36; (C)1·95 × 1·36; (D)2 × 1·32 inches."

This bird is, like its New Zealand congener, very curious, and will come out of its retreat to investigate any unusual sound, such as that caused by knocking two stones or dry sticks together. It can then be easily snared or shot. It is becoming very scarce in the more settled parts of the island, the dogs and pigs destroying birds and eggs. Messrs. Hedley and McCulloch, of the Australian Museum, who made the ascent of Mount Gower in September, 1908, informed me that the Wood Hen was fairly plentiful in the Erskine Valley, and on the slopes of the mountain.

55(M). 6. PORZANA PLUMBEA Gray.

Spotless Crake; Little Tarler Bird(N.I.).

Ortygometra tabuensis Gm., North, 'Nests and Eggs,' p.415; *Porzana tabuensis* Gm., Campbell, p.748.

Hab.—Norfolk Island. (Australia generally, New Zealand, Philippine Islands).

Although the Spotless Crake enjoys such a wide range throughout Australia and adjacent countries, it is not found on Lord Howe Island. At Norfolk Island it is a rare species, and the islanders do not appear to have distinguished it from the Pectoral Rail, as both birds bear the local appellation of Little Tarler(Taro) Bird. North records the finding, by Dr. Metcalfe, of an old nest with an egg in it, and I have another single egg taken from a nest in a "drain" (natural watercourse) in the 100-acre Reserve at Norfolk Island, on the 1st of March, 1909. My collector informed me that the nest was constructed of flags "like a Titerack's"(*Micranous leucocapillus*), and placed in the fork of a

* I have recently received a pair of eggs taken by Mr. Herbert Wilson on the 9th November, 1909. The nest was of Kentia palm thatch, in a hollow on the ground. The shell is glossy, pinkish-white, with red-brown spots and freckles, and more numerous suffused purplish spots scattered over the whole shell, but predominating at the larger end. Dimensions: (*a*)2 × 1·38, (*b*)2 × 1·36.

Taro plant. This egg is nearly elliptical in form, glossy, surface finely pitted; of a buff ground-colour thickly covered with pale reddish and less frequent dark reddish markings, the latter approaching the form of longitudinal streaks. Dimensions: 1·15 × 0·95.

62(M). 7. PORPHYRIO MELANONOTUS Temminck.

Bald Coot; Satin Bird (L.H.I.); Tarler Bird (N.I.).

Porphyrio melanotus Gould, p.321; Ramsay, p.38; North, 'Nests and Eggs,' p.415; Etheridge, 'Lord Howe Island,' p.11; *P. melanonotus* Campbell, p.757.

Hab.—Lord Howe and Norfolk Islands. (Australia generally, Tasmania, New Zealand, New Guinea, Moluccas).

The Bald Coot is not uncommon at Norfolk Island, where it breeds in the creeks and swampy places. Its Norfolk Island local name is a corruption of "Taro" Bird, as it frequents the patches of wild Taro growing in the watercourses. I did not find any nests, but was informed that many young birds were seen in the creeks during the 1908 season. Dr. Metcalfe states that on Norfolk Island the number of eggs laid by this bird is twelve or more (North).

It is only occasionally seen at Lord Howe Island, and I believe there is no record of its having bred there.

63(M). 8. NOTORNIS ALBA White.

White Gallinule.

Notornis alba Ramsay, p.38.

Hab.—Lord Howe Island (extinct).

A great deal has been written about this remarkable bird, and a summary of the references, together with a plate, are contained in Rothschild's "Extinct Birds."

Although generally believed to be absolutely extinct, I should not be surprised to hear of a specimen being taken in the recesses of the mountains, many parts of which have not yet been explored.

PROCELLARIIFORMES.

79(M). 9. PUFFINUS CHLORORHYNCHUS Lesson.

Wedge-tailed Petrel; Little Mutton Bird(L.H.I.).

Puffinus sphenurus Gould; Ramsay, p.38; North, 'Nests and Eggs,' p.37; North, 'Lord Howe Island,' p.47; Etheridge, p.14.

Hab.—Lord Howe and Norfolk Islands. (Australian Seas, Indian Ocean, Pacific Ocean).

The Wedge-tailed Petrel breeds on Nepean Island, which is so honeycombed that it is dangerous to walk over some parts, the thin crusts over the burrows being insufficient to support one's weight. The northern slopes of Phillip Island are similarly riddled, and many birds breed in the shallow holes drilled in the slight soil covering the rocky islets to the north of the main island. I found a pair preparing their burrow on the Redstone in October, 1908.

At Lord Howe Island it breeds on Goat Island in the Lagoon, Mutton Bird Island, and on the Admiralty Islets. Although I was too early to find any eggs, I surprised some birds in the act of clearing out the old burrows preparatory to laying.

I received several eggs from Mrs. Nichols taken in December, 1907. Dimensions: (*a*)2·5 × 1·66; (*b*)2·25 × 1·58(L.H.I., Dec., 1907).

Sir Walter Buller expressed the opinion that Dr. Crowfoot's *P. sphenurus* is *P. griseus*. Crowfoot gave the dimensions of eggs of *P. sphenurus* as varying from 2·5 to 2·75 inches in length, and from 1·5 to 1·75 inches in breadth. These dimensions are sufficiently wide to embrace both species.

80(M). 10. PUFFINUS ASSIMILIS Gould.

Allied Petrel; Lao(N.I.).

Puffinus assimilis Crowfoot, p.269; *P. nugax* Soland., North, 'Nests and Eggs,' p.377; Ramsay, p.38.

Hab.—Norfolk Island. (Australian Seas, Atlantic Ocean).

The Allied Petrel breeds on Phillip and Nepean Islands, and on the rocky islets on the northern side of Norfolk Island, during the months of July and August. On the 28th October, 1908, I visited the Redstone, one of the latter islets, and found the shallow nesting holes of this Petrel deserted, although one recently dead young bird was lying in a hole. No doubt this was a late hatched bird, abandoned by its parents at the time of the general migration. The Wedge-tailed Petrels were arriving at the date of my visit, and had commenced to dig out their burrows.

The Allied Petrel lays a single egg on the sand in a shallow burrow, or under an overhanging rock. It is pure white, rather graceful in shape, and inclined to be pointed at the ends. Dimensions of two specimens presented to me by Dr. Metcalfe: (*a*)2·04 × 1·38(taken 25th July, 1901); (*b*)1·94 × 1·4(taken 23rd July, 1892).

82(M). 11. Puffinus griseus Gmelin.

Sombre Petrel; Ghost Bird(N.I.).

Puffinus sphenurus, Crowfoot, p. 268.

Hab.—Norfolk Island. (Australian Seas, Atlantic Ocean, Pacific Ocean).

This bird breeds extensively on the high land about Anson Bay, Norfolk Island, in the vicinity of the Cable Station. The local name of this bird is derived from its weird and mournful cry. I have eggs of this species taken by Master Jack Jacobs, during December, 1908, in this locality. Dimensions: (*a*) 2·58 × 1·78; (*b*)2·6 × 1·6.

84(M). 12. Puffinus tenuirostris Temminck.

Short-tailed Petrel (Mutton Bird); Mutton Bird(L.H.I.)

Nectris brevicaudus Brandt, Ramsay, p.38; North, 'Nests and Eggs,' p.378; North, 'Lord Howe Island,' p.47; Etheridge, 'Lord Howe Island,' p.14.

Hab.—Lord Howe Island. (Australian Seas, Pacific Ocean, New Zealand, N. to Japan).

This Petrel, the "Mutton Bird" of Tasmania, breeds in large numbers on Lord Howe Island, its chief "rookery" being in the sandy soil of the eastern side of the Island. There is a beautiful palm-glade here, where the interlaced foliage overhead is so thick that the sun's rays do not penetrate it, and the islanders have given this spot the somewhat gloomy name of the "Valley of the Shadow of Death." At night time, during the months of October, November, and December, this Valley is full of weird moanings and wailings, enough to make one's flesh creep. They are, however, only the conversational efforts of the Mutton Birds as they meet a friend (or foe) when digging their burrows, or coming in from the day's feeding. The unwary visitor frequently plunges through the thin layer of sand over these burrows, which extend in some cases to a distance of ten feet from the entrance. A single egg is laid at the end of the burrow during the last week of November. It is pure white, generally pointed oval in shape, but varying occasionally to an almost elliptical form. The size also varies considerably. Dimensions of two specimens selected from a number taken by Mrs. Nichols in December, 1907: (*a*), 2·8 × 1·8 (pointed oval); (*b*), 2·5 × 1·7 (elliptical).

88(M). 13. MAJAQUEUS ÆQUINOCTIALIS Linnæus.

Spectacled Petrel.

Majaqueus gouldii Hutton, Ramsay, p.38.

Hab.—Lord Howe Island. (Australian Seas, Atlantic Ocean).

This bird appears to be merely a visitor to the seas adjacent to Lord Howe Island. There is no evidence of its having bred either on this Island or on Norfolk Island.

95(M). 14. ŒSTRELATA NEGLECTA Schlegel.

Big Hill Mutton Bird (L.H.I.).

Procellaria phillipii Gray.

Œstrelata phillipii G. R. Gray, North 'Nests and Eggs' p.416; Hutton, "Petrels of the Kermadec Islands," Proc. Zool. Soc., iv. p.755 (1893).

Hab.—Lord Howe Island, Norfolk Island. (New Zealand, Kermadec Islands).

According to Hutton, on the authority of Cheeseman, *Œstrelata neglecta* breeds in the open, and does not burrow like other petrels. It is known that this species and *Œ. neglecta* var., Hutton, are variable species as regards colour.

An adult and a young bird out of the birds breeding on Mount Gower (Lord Howe Island) were procured by Messrs. Hedley and McCulloch, of the Australian Museum, in September 1908. These were identified by Mr. A. J. North as *Œ. neglecta.* The adult bird does not accord with any of the published descriptions of *Œ. neglecta* to which I have had access, the back being bluish-black, the head sooty-brown, breast brown, throat washed darker, feathers surrounding the bill tipped with white, all feathers white underneath, bill and feet black.

Mr. Herbert Wilson, of Lord Howe Island, who has frequently observed the local bird breeding, informs me that he never saw it in any but the dark colour. The nest is composed of "cut grass" or small fibrous roots, placed in a chamber at the end of a burrow, from two to four feet in length, or in a deep crevice in the rocks. In some cases the mass of nest-material is so large, that the young bird is almost concealed in it. The parent bird can be attracted to the entrance of the burrow by a "cooee" from outside; and when molested she bites savagely. The breeding season is during July and August, fairly large numbers frequenting the top and south-western slope of Mount Gower, at an altitude of over 2000 feet above sea-level. Formerly, it is stated, this bird bred lower down, but the pigs drove them to less accessible situations.

With regard to the Norfolk Island bird,(*Œ. phillipii*) North states* : "This species Dr. Metcalfe informs me is very difficult to procure on account of its nocturnal habits, and is only to be obtained about January, when it resorts to the west side of the Island to breed, depositing a single egg at the end of a burrow in the sandy soil. During a period of ten years he has only obtained two birds and three eggs, one of the latter of which he has kindly forwarded; it is ovoid in form, of a dull white, the surface of the shell having numerous shallow pittings, although smooth to the touch, and presenting a glossy appearance. Length 2·14 × 1·16 inches*."

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* Nests and Eggs, p.416.

With every possible deference to the authorities who have merged *Œ. phillipii* into *Œ. neglecta*, and to the identification of the Lord Howe Petrel by Mr. North, I am of opinion that the birds represent four distinct species. Further information as to the description and habits of *Œ. neglecta* may be anticipated from the investigations of Messrs. T. Iredale and party, who spent nearly the whole year 1908 on the Kermadecs. I have several eggs of the two Kermadec Island species, presented to me by Mr. Iredale, the dimensions of which are as follows:— *Œ. neglecta* (Sunday Island): (*a*)2·45 × 1·67; (*b*)2·44 × 1·78; (*c*) 2·6 × 1·85 (5th Nov., 1908). *Œ. neglecta*, var. (Meyer Island): (*a*)2·48 × 1·62;(*b*)2·47 × 1·86 (24th April, 1908).

The following table shows the marked dissimilarity in the four birds, their habits, and the dimensions of their eggs:—

Species.	Bird.	Nest.	Egg.	Breeding season.
Lord Howe Petrel.	Uniform in colour.	At end of a burrow.	...	July-August.
Norfolk Island Petrel.	,,	,,	2·14 × 1·62	January
Œ. neglecta (Sunday Island)	Very variable in colour.	In the open.	2·44-2·6 × 1·67-1·85.	October-November.
Œ. neglecta var. (Meyer Island)	,,	,,	2·47 × 1·62-1·86.	April-May.

105(M). 15. Prion desolatus Gmelin.

Dove-like Prion.

Prion turtur Smith, Ramsay, p.38.

Hab.—Lord Howe Island. (Australian Seas, Antarctic Seas, S. Atlantic Ocean).

Mr. H. Wilson, of Lord Howe Island, informed me that he had occasionally found dead birds of this species on the cliffs of the main Island, and one was found in a dying condition on the Admiralty Islet. He has never found it breeding.

LARIFORMES.

128(M). 16. STERNA FULIGINOSA Gmelin.

Sooty Tern; Wideawake(L.H.I.); Whale Bird(N.I.).

Sterna fuliginosa Crowfoot, p.266; North, 'Nests and Eggs,' p.374; North, 'Lord Howe Island,' p.46; Etheridge, p.15.

Onychoprion fuliginosa, Ramsay, p.38; Ramsay, Proc. Linn. Soc. N.S.Wales, ii. (2nd Ser.), p.678(1887).

Hab.—Lord Howe and Norfolk Islands. (Australia generally, Atlantic, Indian, and Pacific Oceans).

The Lord Howe Islanders' name for the Sooty Tern is said to be derived from a fancied resemblance between its ordinary cry and the word "wideawake," but it might just as well be a reference to its attitude and actions as compared with the stolid Noddy. The name given to it by the Norfolk Islanders is derived from its periods of arrival at and departure from the Island, which are coincidental with those of the whales, the pursuit of which is one of the chief of the island industries.

At both islands I had abundant opportunities of seeing the Sooty Terns in their breeding places, and selecting a fine series of their remarkably variable eggs from many hundreds of thousands scattered about within easy reach.

On the main island of Lord Howe these birds assemble to breed in one restricted locality only, the North Ridge, a steep slope about two miles to the northward of the settled part of the island. The south-western slope of this ridge is covered with thick tussocky grass, amongst which a few basalt boulders protrude their rugged heads; while the north-eastern side descends sharply several hundred feet to the ocean, the cliff being broken by occasional terraces on which the birds find a more or less secure nesting place, though the major part of the colony occupy the south-western slope. During the season, which extends from the middle of September until the end of November, this breeding place is frequently visited, in fact almost daily, by parties of the residents who collect the freshly laid eggs in kerosene tins and buckets. These eggs form an agreeable addition to the food-supply, and are cooked in various ways, the principal being plain hard-boiled, eaten cold, or made into large omelettes. The albumen when boiled is almost transparent, and of a faint bluish-white, similar to that of the domestic duck's egg, while the yolk is of a deep salmon-pink. They have practically no fishy flavour, and are not so rich as the domestic hen's eggs. I tried them cooked in several ways, and found the cold hard-boiled variety with salad fairly palatable, but on the whole hardly an article of diet to hanker after! The industry of collecting these eggs for food has resulted in the evolution of a local term, viz., "Wide-awakaneggin."

On the North Ridge breeding-place there were probably not more than two thousand birds established, and the periodical collections of eggs would total less than 500 at a time. There is every reason to believe that a bird will lay again very soon after being robbed. I have seen the ground cleared of eggs at ten o'clock in the morning, and by three o'clock in the afternoon a hundred more were laid within the same area. I am inclined to think that this frequent laying of eggs by birds which, in the ordinary course of nature would be satisfied to lay and hatch out one egg in the season, is largely the cause of so much variety in the colour-markings and dimensions of the eggs. Those observed by me on the Admiralty Islets, which are rarely visited, were almost uniformly of the normal type, viz., faintly bluish or white ground, with reddish spots, dashes, or freckles distributed fairly evenly over the whole shell. On the day of my visit to those Islets(16th October, 1907) there were many hundreds of thousands of eggs to select from, and it was with difficulty that I could find a couple of dozen sufficiently well or unusually marked to attract notice. The same may be said of the eggs on the higher parts of Phillip Island off Norfolk Island. On the other hand, the eggs taken from the North Ridge, Lord Howe Island, and from Nepean Island and the more easily accessible islets off Norfolk Island, which are raided almost daily during the season, exhibit the most extraordinary variation in both colour and size. Eggs covered with huge carmine blotches and streaks, pure white eggs, and others with a deep brownish-red ground spotted with darker markings are quite numerous, while some most remarkable departures from the normal in size and shape are found, mostly towards the close of the season. The latter particularly, to my mind, are strongly evidential of the strain caused by the unnaturally large output of individual birds.

At Norfolk Island the season commences a month or more later than at Lord Howe Island, and continues up to December. The Bird Protection Regulation in force there allows the eggs to be taken without limit from the commencement of the season until the 21st November. On and after that date it is a punishable offence to take any eggs. This is a wise restriction, and its beneficial effects can be seen in the large numbers of birds that breed every year on Nepean Island. Although it is not unusual for a boat-load of 10,000 to 15,000 eggs to be brought in from the Island two or three times a week, there is said to be no apparent diminution in the number of birds breeding there each year. At Lord Howe Island, where there is no restriction, and the birds have practically no rest, the numbers breeding on the main Island are dwindling year by year. Here also, they have another relentless enemy, the hungry semi-wild pig, which will go through the more easily accessible nests and guzzle the eggs, shells and all, and does not stop to inquire whether they are fresh or otherwise.

The Sooty Tern rarely makes any nest-structure. Very occasionally a few grass-stems may be found arranged round a slight depression, but in the vast majority of instances the egg is laid upon the bare soil or sand, or on the natural grass, whichever may be the surface of the spot selected for depositing the egg. On the Admiralty Islet which I visited, there are several broad terraces, with tussock-grass growing amongst the loose stones. Here the Sooty Terns were clustered so closely, each bird sitting on an egg or a chicken, that it was impossible to avoid treading occasionally on the contents of a nest. The loose clayey soil was hollowed out a little where practicable, otherwise the egg was laid between two small stones, or in the middle of a tussock. In all directions old abandoned eggs could be seen sticking in the earth which had been washed over them by the rain. On Phillip Island I saw in one dry watercourse, thousands of rotten eggs, and many hundreds of dead birds caught in the roots or half buried in the sand. Owing to this Island being almost entirely denuded of undergrowth by the rabbits, the rain very rapidly finds its way into the watercourses, and as the Sooty Tern will not leave its egg, those birds that have selected the soft sandy beds of these watercourses are soon drowned. In the latter part of November, and during the whole of December, 1908, Norfolk Island was visited with an almost unprecedented rainfall. My friend, Mr. Lindsay Buffett, informed me that the resulting mortality amongst the Sooty Terns was enormous.

One egg only is laid for a sitting. Although I saw several birds on the Admiralty Islet sitting on two eggs, and took half-a-dozen of these pairs for examination, in every case one egg proved to be addled, while the other was either fresh or in active process of incubation. The addled egg was doubtless one which had been abandoned, and, owing to the limited space available, the then sitting bird had laid one egg alongside of it, rather than take the trouble to remove it.

The Sooty Terns are not shy, but, when first disturbed, will rise and hover about, scolding vigorously and snapping their mandibles. They soon settle again, and it is not difficult to catch them with the hand.

As previously remarked, the eggs differ greatly in colouring and dimensions, and a large series of selected varieties makes a most striking addition to the cabinet. I have several white or faintly bluish specimens without any trace of markings; then some with a few faint reddish spots or blotches, and others ranging through all gradations of ground-colour and markings up to a terra-cotta ground, thickly sprinkled with blackish-brown and dark red spots and blotches. Some have distinct zones of colour on a white ground; others again bear great masses of suffused purplish colour, appearing as if beneath the shell, and scattered red spots overlying them. Many are spirally streaked with rich carmine, while others have caps of almost black blotches.

The following are the dimensions of some normal, and some remarkable divergences from the normal, eggs in my collection—(1)2 × 1·4; (2)2·39 × 1·4; (3)1·8 × 1·35; (4)1·7 × 1·4; (5)1·45 × 1·06; (6)1 × 0·84; (7)2·1 × 1·4; (8)1·9 × 1·5; (9)2·55 × 1·3(pyriform); (10) 1·46 × 1.

132(M). 17. PROCELSTERNA CINEREA Gould.

Grey Noddy; Blue Billy(L.H.I.); Patro(N.I.).

Procelsterna albivitta Gould, p.420.

Anous cinereus, Crowfoot, p.265; Ramsay, p.38; North, 'Nests and Eggs,' p.376; North, 'Lord Howe Island,' p.46; Etheridge, p.15.

Procelsterna cinerea, Cat. Birds Eggs, B.M., i., p.197(1901).

Hab.—Lord Howe and Norfolk Islands. (N. and E. Australia, New Zealand to San Ambrose Islands, S.W. America).

This beautiful little Tern breeds in both groups of islands. At Lord Howe it selects crevices and ledges in the precipitous cliffs on the north-eastern side of the main island, and similar places on the Admiralty Islets. The nests are generally very difficult of access. In the Norfolk group it breeds chiefly on Nepean and Phillip Islands, and on the former the nests are comparatively easy of access, being placed in crevices of the weathered volcanic rock from a few feet to a considerable height from the water-line. Owing to the horizontal position of the strata, and the weathering having formed sloping terraces, the cliffs are not difficult to scale, although the sharp, worn edges and points of rock are unpleasant to hands and knees.

The breeding season commences about the middle of September at Lord Howe Island and a little later at Norfolk Island, and extends over the three following months. The birds do not breed in colonies, but certain spots or localities are more favoured than others. The bird is, however, by no means common in either group.

A single egg is laid for a sitting, and the nest is seldom much more than a depression in the sand which has drifted into the crevice, with a few bits of grass or dry seaweed loosely scattered about. The egg is very fragile, somewhat similar in general appearance to that of the Noddy, but the ground-colour is more a greyish stone-colour. The reddish-brown spots are sparingly distributed over the whole shell, and a few purplish-grey suffused markings are also generally distributed. In shape they are more or less pointed ovals, and they vary considerably in size. Dimensions: (1)1·7 × 1·2(Admiralty Islet, 15/x./07); (2)1·8 × 1·2(Lord Howe I., 26/ix./08); (3)1·65 × 1·18(Lord Howe I., 26/x./08); (4)1·6 × 1·16 (Nepean Island, 15/x./08); (5)1·6 × 1·12(Nepean Island, 15/x./08); (6)1·5 × 1·12(Nepean Island, 31/x./08).

133(M). 18. ANOUS STOLIDUS Linnæus.

Noddy; Noddy(L.H.I., and N.I.).

Anous stolidus, Crowfoot, p.264; Ramsay, Proc. Linn. Soc. N. S. Wales, ii., 2nd Ser., p.678, 1887; Ramsay, p.38; North, 'Nests and Eggs,' p.375; North, 'Lord Howe Island,' p.46; Etheridge, p.15; Cat. Birds Eggs, B.M., i. p.198, 1901; Campbell, p.851.

Hab.—Lord Howe and Norfolk Islands. (Tropical and juxta-tropical seas of the world).

At Lord Howe Island the Noddy breeds only on the Admiralty Islets, visiting the main island for feeding purposes only. During my visit to the large Admiralty Islet, I found several hundreds of these birds nesting amongst the twisted limbs of some dead shrubs lining the edge of a cliff. The nests were constructed of dry grass and seaweed loosely packed together, with a moderate depression in the centre; they were placed very close together, the shrubs being literally covered with them. Later comers who had failed to secure a branch had fain to be content with the ground beneath the bushes. The eggs were for the most part far advanced in incubation(16/x./07).

At Norfolk Island the Noddy also avoids the main island, breeding only on the rocky islets, Nepean and Phillip Islands. On Nepean Island I saw large numbers of birds on October 15th, 1908, but nesting had not commenced. The birds were very tame, and sat in groups gravely inspecting us a couple of yards distant, as we discussed our lunch. They have an inexpressibly sly look, owing to the white line under the eye.

In this group the nests are most frequently placed on the ground, owing to the absence (except at Phillip Island) of any trees or even shrubs. Dr. Metcalfe(Crowfoot, Ibis) says: "The eggs are not laid in large colonies, but here and there in convenient spots, all over the island. The Noddy always makes some kind of a nest. I have seen it made of dry grass, bits of seaweed, dry sticks or twigs, and fish bones. As a rule there is nothing but a basement made. The material is merely laid in a heap, as it were, in a shallow hollow, and the egg, only one, is laid thereon. In one instance I found a considerable attempt at building a nest on the top of a dead tree-stump, about three feet from the ground; it consisted of a mass of grass, twigs, and seaweed, but there was no interweaving of the materials."

Breeding commences in October and extends into January. The eggs vary from creamy-white to warm pinkish-white, and are generally sparingly marked with brownish-red or dark red spots and blotches, and pale purplish suffused blotches. Occasionally one of these suffused markings is very extensive. As a rule the markings are more frequent at the larger end, but one remarkable specimen I obtained from the Moöo Stone (a rock near Norfolk Island) is heavily blotched with masses of rich yellow-brown and dark brown extending in the form of an irregular zone round the middle of the egg, while a few streaks and spots are sparingly scattered towards the ends, both of which are unmarked. The ground-colour of this egg is a rich cream.

Sometimes these eggs approach rather closely to some of the more sparsely marked eggs of the Sooty Tern, but the collector who has the privilege of "picking over" a boat-load of eggs brought in by the islanders, can always distinguish the species when blowing the eggs, as the yolk of the Noddy's is pale yellow; that of the Sooty Tern's egg being salmon-pink.

The eggs vary in size and shape, but in a far less marked degree than those of the Sooty Tern. I have not found any of abnormally small size. Dimensions: (Nos. 1-5, Admiralty Islet, 16/x./07); (1)2·2 × 1·54; (2)2·2 × 1·4; (3)2·06 × 1·4; (4)2·24 × 1·3; (5)2 × 1·46; (6)1·98 × 1·4 (Nepean Island, 12/xi./08).

135(M). 19. MICRANOUS LEUCOCAPILLUS Gould.

White-capped Noddy; Titerack (N.I.).

Anous melanogenys, Crowfoot, p.264; Ramsay, p.38; North, 'Nests and Eggs,' p.376.

Micranous leucocapillus, Cat. Birds Eggs, B.M., i. p.199, 1901; Campbell, p.856.

Hab.—Norfolk Island (breeding), Lord Howe Island (accidental). (N. and E. Australia, Pacific and Indian Oceans, S. Africa, E. America, Caribbean Sea).

The White-capped Noddy breeds on Norfolk and Phillip Islands. Although a number of the birds visited Lord Howe Island early in February, 1909, they only remained there a fortnight; and I am informed that this is the only recorded instance of their occurrence at that Island. I have seen a photograph of these visitors, from which their identity is established.

I visited Phillip Island on 3rd November, 1908; and, after a stiff climb up the steep and crumbling slopes leading to the higher levels of the island, discovered that large colonies of the "Titeracks" were sitting on their recently laid eggs. From a dozen to a hundred or more birds take possession of one of the large White Oak (*Lagunaria Patersoni*) trees, and adorn every convenient fork or other suitable place, not despising a broad horizontal branch with a few upright shoots, with their compact little nests of brightly coloured seaweeds brought fresh and damp from the rocks, and pressed into cushion-shape, with a slight depression in the centre. The birds display considerable taste in the selection of strikingly contrasted colours, red, green, and purple seaweeds being matted together with strands of the broad "Moöo" grass.

In some of the deep watercourses the oak-trees were dwarfed, and threw out horizontal branches of great length. From these again sprang short straight shoots, generally in clusters of four or six. These bunches of shoots made admirable supports for the matted nests, and it was possible to reach some of the lower branches from the ground. Having collected the eggs from these, one could ascend and walk along them in order to collect from the next tier of branches. My friend, Mr. Lindsay Buffett, who accompanied me on this expedition, said that my excursions along these branches gathering eggs reminded him of a delighted schoolboy picking apples in an orchard!

The colonies do not commence to breed on the same day, as we found nests in course of construction, fresh eggs, and others well advanced in incubation on the same tree.* The birds were not shy, but generally left the nests when we were within reach, and sidling along the branch, uttered the querulous cry which has earned them their local appellation.

The rapid destruction of the timber on this island, resulting from the herbage being eaten out by the rabbits, is evidenced by the number of fallen oaks, gradually becoming bleached or decaying skeletons. On some of these former homes of the Titeracks a few birds still breed among the dead twigs, and even on the upturned roots. There are also several trees, both White Oaks and Pine trees, on Norfolk Island where the White-capped Noddy breeds. I visited two localities in the vicinity of Steel's Point and Duncombe Bay, but although the birds were roosting there, they had not commenced to build by the middle of November, 1908.

A single egg is laid, of a white, creamy, or warm pinkish ground, more or less spotted or blotched with deep reddish and chocolate-brown, and with purple suffused markings. In some cases the markings are scattered over the whole shell, in others forming a cap at the larger end, and in others again a more or

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* In the season of 1909, fresh and incubated eggs were taken on 15th December.

less distinct zone. A few eggs are white, almost entirely devoid of markings. The shape is from elongated to stout oval, and the size varies considerably. Dimensions: (1)1·8 × 1·3; (2)1·86 × 1·25; (3)1·85 × 1·20; (4)1·74 × 1·26; (5)1·72 × 1·23; (6)1·64 × 1·20.

136(M), 20. GYGIS ALBA Sparrm.

White Tern; White Bird(N.I.).

Gygis candida Gmelin, Gould, p.405; Crowfoot, p.266; Ramsay, p.38; North, 'Nests and Eggs,' p.374.

Gygis alba, Cat. Birds Eggs, B.M., i. p.200, 1901; Campbell, p.857.

Hab.—Norfolk Island. (N. and E. Australia, Pacific, Indian and S. Atlantic Oceans).

My principal object in visiting Norfolk Island was to see this beautiful bird, and study its remarkable breeding habits. On my arrival at the island (8th October, 1908) I was informed that the "White Birds" had not yet commenced to lay, although a few had been seen at their usual breeding haunts. On the 14th, I visited the Pacific Cable Station at Anson Bay, on the western coast, and there saw several birds flying about the great White Oak trees(*Lagunaria Patersoni*), but none appeared to be sitting. I visited Steel's Point, on the eastern coast, on the 17th of October, and there had the satisfaction of handling my first specimens of the beautiful eggs of *Gygis alba*. Many subsequent days were spent in visiting the two breeding localities, one extending along the eastern coast from Ball Bay to Steel's Point, and the other on the western coast from Selwyn Bridge, past Anson Bay to Duncombe Bay on the north. On these occasions I watched the birds, from the laying of the egg to the hatching and rearing of the young ones, and will now give a general description embracing the result of my observations extending over one month.

The White Tern breeds in the densely wooded gullies, not in colonies in the strict sense of the term, but widely scattered over the two localities mentioned. The single egg is deposited in a knot-hole or any slight depression on a more or less horizontal limb of one of the forest trees, preference being given to that great Hibiscus, the White Oak (*Lagunaria Patersoni*). This tree is given to sending out shoots, which die and leave a small hole around which the bark thickens into a ridge an inch or more in height, thus forming an admirable resting-place for the Tern's egg. The broad flattish upper surface of the limbs of the other trees, frequently overgrown with lichens or masses of Spanish moss with pendent streamers, also offer reasonably secure accommodation for the eggs, while less frequently the moss-grown lower branches of the Norfolk Island Pine-tree (*Araucaria excelsa*) are utilised. No material to form a support of any kind for the egg is added to the spot selected for its resting-place.*

In only three instances did I find an egg at a height of less than twenty feet from the ground, the general height being from thirty to sixty feet. As a rule one pair of birds only inhabits a tree, but from one large oak near the Cable Station two eggs were taken on the same day, and three other birds were sitting close as if on eggs, but in quite inaccessible positions on thin dead branches. The Tern generally selects trees sheltered from the direct force of the prevailing winds from the sea, and the

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* Snodgrass and Heller, in their paper on the Birds of Clipperton and Cocos Islands (Proc. Wash. Acad. Sc., iv., p.511, 1902), referring to this bird, state:—"Abundant in July at Cocos Island, where it was nesting in the tops of tall trees a short distance inland, in company with *Micranous diamesus*. We did not secure any eggs. The nests, built of twigs, somewhat resemble those of a crow. Many nests were frequently found in one tree. The birds were difficult to obtain from the water, for in flying back and forth from their nests they nearly always remained at the same elevation as the nests."

I am of opinion that the authors were in error in attributing the nests "built of twigs" to the White Tern; they no doubt belonged to the Micranous. It does not appear possible that the same species would exhibit such different habits in two localities where the conditions were practically identical as regards site, vegetation, and facilities for procuring material for constructing nests were such required.

sitting bird puffs out its breast-feathers so as to completely hide the egg, depressing its forked tail so as to obtain as secure a hold as possible, and sits with its beak pointing into the eye of the wind, so as to offer the least resistance. Its position may thus be either facing along the limb, or across it diagonally, or at right angles. It sits close until the intending robber is almost within reach, when it raises its wings and, gently fluttering them, "tiptoes" sideways off the egg and hovers about uttering a guttural "heech, heech." Both parents share in the task of incubation, and when changing guard the male bird circles round, uttering his cry, and as he settles on the limb balancing himself with raised wings, the hen sidles off, and he with equal caution takes her place. Although in a few instances I found birds inhabiting adjoining trees, they were generally widely scattered, and frequently a quarter of a mile was covered between nests. Owing to the dense growth and the height at which the birds laid their eggs, the most successful plan for locating them was to ascend to the top of a ridge and scan the trees growing on the opposite side of the gully. On a sunny day the gleaming white plumage of the bird was conspicuous against the dark green of the leaves or the grey of the branches. After noting the position of the tree, a plunge through the thick undergrowth to the bottom and a toilsome scramble up the other side led to a search for the inhabited tree, which often proved far more formidable to climb than it appeared from a distance. The island boy who accompanied me was an excellent climber, and so long as he could get a clasp round two-thirds of the circumference, or the bark was sufficiently rough, he would swarm up with the soles of his bare feet clasping the trunk, and when the first branch was reached the rest was easy. Where, owing to the ridges being timbered as densely as the valleys, a sight of the opposite side could not be obtained, a careful search for the white splashes on the leaves of the undergrowth generally located a bird, and a prospecting tour up the tree was rewarded in many cases.

In one instance I found a bird sitting on an egg deposited on the splintered top of a dead bloodwood, about 15 feet from the ground, in the most precarious position of all I saw. The stump was so rotten that it swayed and creaked as my climber wormed his way upward, and when the bird flew off, the egg stood revealed balanced on such an attenuated point that its entire outline could be distinctly seen against the background. The surrounding vegetation was so dense that no breath of wind could reach it, but had it been fated to hatch out, one wonders how the young bird would have fared on such a slender support!

One egg, just chipping when found, was left to hatch out on 24th October. On the 31st I saw the young bird, a ball of black down, squatting unconcernedly on the bare limb while its parents were away searching for food. A week later it was still there, and had then grown nearly as large as its mother, but was still covered with the black down. Its mother flew up, and straddled over it, vainly endeavouring to cover it. There it sat blinking down at us, like a black picaninny in the arms of a white nurse!

The eggs vary in size very slightly, in comparison with those of other Terns, and in colour-markings they vary to a less striking degree, maintaining the same general characteristics, but no two individual eggs are exactly alike. Elliptical in shape, they differ somewhat in length, but I have not seen any specimens approaching an ovate shape, or any abnormally small specimens.

The first egg was taken by me on the 17th October, but the birds generally commence to lay a little earlier, and if robbed, they lay again, but not until some weeks have elapsed. The last egg taken for me during the 1908-9 season was procured on the 28th February, 1909.

Dimensions of six selected specimens showing the greatest variation :—

(1) 1·9 × 1·28 (31st October, 1908).
(2) 1·8 × 1·34 (15th December, 1908).
(3) 1·8 × 1·2 (10th December, 1908).
(4) 1·67 × 1·3 (15th December, 1908).
(5) 1·66 × 1·22 (31st October, 1908).
(6) 1·58 × 1·3 (31st October, 1908).

CHARADRIFORMES.

143(M). 21. ARENARIA INTERPRES Linnæus.
Turnstone.

Strepsilas interpres, Ramsay, p.38.

Hab.—Lord Howe and Norfolk Islands (visitor only). (Australia generally, N. Asia, N. America).

A Turnstone was shot at Lord Howe Island by Mr. L. Waterhouse in October, 1903, and the skin is now in the possession of Mr. John Waterhouse, of Chatswood.

151(M). 22. CHARADRIUS DOMINICUS Müller.
Lesser Golden Plover; Snipe (L.H.I., and N.I.).

Charadrius xanthocheilus Gould; Ramsay, p.38.

Hab.—Lord Howe and Norfolk Islands (visitor only). (Australia generally, Tasmania, Sub-Arctic regions of both hemispheres).

This Plover visits both groups in large flocks during the months from September to December. It feeds along the beaches and over the cultivated and grassed paddocks, generally accompanied by a few Whimbrels.

152(M). 23. OCTHODROMUS BICINCTUS Jardine & Selby.
Double-banded Dottrel.

Ægialitis bicinctus, Ramsay, p.38.

Hab.—Lord Howe and Norfolk Islands (visitor only). (Australia generally, Tasmania, New Zealand, *breeding*).

This Dottrel is rarely seen at either group, and is not distinguished by any local name. I saw a pair feeding on the northern end of the coral reef at Lord Howe Island in October, 1907, and another pair flying restlessly about Back Beach on the eastern side of the island during the same month.

161(M). 24. HIMANTOPUS LEUCOCEPHALUS Gould.
White-headed Stilt.

Himantopus leucocephalus, North, Rec. Aust. Mus. ii., p.36, 1892.

Hab.—Lord Howe and Norfolk Islands (visitor only). (Australia generally, Tasmania, New Guinea, Molucca Is., Greater Sunda Is.).

A skin of this species was forwarded to the Australian Museum by Dr. P. H. Metcalfe, who obtained it at Norfolk Island in April or May, 1892. A similar one was obtained the previous year by Mr. T. R. Icely, visiting magistrate at Lord Howe Island (North).

165(M). 25. NUMENIUS VARIEGATUS Scop.

Whimbrel; Curlew(L.H.I.); Shipmate(N.I.)

Numenius uropygialis, Gould; Ramsay, p.38.

Hab.—Lord Howe and Norfolk Islands (visitor only). (Australia generally, Tasmania, E. Siberia, Japan).

The local name given to this bird by the Norfolk Islanders is derived from its habit of associating in twos or threes with the large flocks of the Lesser Golden Plover, locally known as "Snipe." The Whimbrel usually keep with the Plover, but on the outskirts of the main flock, and they are generally the first to fall to the pothunter's gun. At Lord Howe Island I have counted as many as thirty Whimbrel in a paddock attached to Mrs. Nichol's residence, where they fed unconcernedly, hardly taking any notice of me as I passed within easy gunshot.

167(M). 26. LIMOSA NOVÆ-ZEALANDIÆ Gray.

Barred-rumped Godwit.

Limosa uropygialis, Gould; Ramsay, p.38.

Hab.—Lord Howe Island(visitor only). (Australia generally, Tasmania, New Zealand, Oceania, Alaska, E Siberia).

I did not see this bird on either group of islands, but two specimens were shot at Lord Howe Island by Mr. L. Waterhouse in October, 1903.

181(M). 27. HETEROPYGIA AURITA Latham.

Marsh Tringa.

Hab.—Lord Howe Island(visitor only). (Australia generally, Tasmania, New Zealand, E. Siberia, China, Alaska).

Three specimens of this bird were shot at Lord Howe Island by Mr. L. Waterhouse in October, 1903.

185(M). 28. GALLINAGO AUSTRALIS Latham.

Snipe.

Gallinago australis, North, Rec. Aust. Mus. v. p.337(1904).

Hab.—Lord Howe Island(visitor only). (Australia, Tasmania, New Zealand, Formosa, Japan).

A specimen was obtained by Mr. Waterhouse at Lord Howe Island in the spring of 1903(North).

ARDEIFORMES.

197(M). 29. PLATALEA REGIA Gould.

Black-billed (Royal) Spoonbill.

Platalea melanorhyncha, Reich.; North, Rec. Aust. Mus. ii. p.36(1892).

Hab.—Norfolk Island (visitor only). (Australia generally, New Zealand, *accid.*, Molucca Is., S. Borneo).

A skin of this species was forwarded to the Australian Museum by Dr. P. H. Metcalfe, who obtained it at Norfolk Island in April or May, 1892.

203(M). 30. HERODIAS TIMORIENSIS Lesson.

White Egret.

Herodias egretta Gmelin; North, Rec. Aust. Mus. ii. p.36(1892).

Hab.—Lord Howe and Norfolk Islands (visitor only). (Australia generally, New Zealand, Philippine Is., China, Japan).

A skin of this species was forwarded to the Australian Museum by Dr. P. H. Metcalfe, who obtained it at Norfolk Island in April or May, 1892.

204(M). 31. NOTOPHOYX NOVÆ-HOLLANDIÆ Latham.

White-fronted Heron; Crane(L.H.I. and N.I.).

Ardea novæ-hollandiæ, Ramsay, p.38.

Hab.—Lord Howe and Norfolk Islands (visitor only). (Australia generally, Tasmania, New Zealand, New Caledonia, New Guinea, Celebes, Molucca Is.).

This Heron appears to be a by no means infrequent visitor at both groups, although it has not been known to breed on either. At Lord Howe Island I saw five White-fronted Herons on the south end of the coral reef in October, 1907

210(M). 32. NYCTICORAX CALEDONICUS Gmelin.

Night Heron.

Nycticorax caledonicus, Ramsay, p.38.

Hab.—Lord Howe Island (visitor only). (Australia generally, Tasmania, New Zealand, New Guinea, Admiralty Is., Pelew Is., Celebes).

212(M). 33. ARDETTA PUSILLA Vieillot.

Little Bittern.

Ardetta minuta, Linn.; Ramsay, p.38.

Hab.—Lord Howe Island(visitor only). (Australia generally, New Zealand).

This is given on Ramsay's authority, but its occurrence is doubtful.

ANSERIFORMES.

226(M). 34. ANAS SUPERCILIOSA Gmelin.

Black Duck; Duck (L.H.I., and N.I.).

Anas superciliosa, Ramsay, p.38.

Hab.—Lord Howe Island(visitor only), Norfolk Island. (Australia generally, Tasmania, New Zealand, New Guinea, Sunda Is).

The Black Duck is an occasional visitor to both Islands, but on one occasion, Dr. P. H. Metcalfe informed me, a pair bred on Norfolk Island, a nest containing five eggs being found by him.

PELICANIFORMES.

238(M). 35. PHALACROCORAX SULCIROSTRIS Brandt.

Little Black Cormorant; Shag(L.H.I., and N.I.)

Graculus sulcirostris, North, Rec. Aust. Mus. ii, p.36(1892).

Hab.—Lord Howe Island and Norfolk Island(visitor only). (Australia generally, Tasmania, New Zealand, New Guinea, Molucca Is. to S. Borneo).

A skin of this species was sent to the Australian Museum by Dr. P. H. Metcalfe. It was obtained, with other occasional visitors to Norfolk Island in April and May 1892. I did not see this bird during my visit to the Island, but was informed by Mrs. Laing that several had been seen there at various times.

241(M). 36. PHALACROCORAX MELANOLEUCUS Vieillot.

Little Cormorant.

Graculus melanoleucus, Ramsay, p.38.

Hab.—Lord Howe Island (visitor only.) (Australia generally, Tasmania, New Zealand, New Guinea, Molucca Is., Sunda Is.).

244(M). 37. SULA CYANOPS Sundevall.

Masked Gannet; Booby and Fish-bird (L.H.I.); Gahnet (N.I.).

Sula personata, Gould; Crowfoot, p.269.

Sula cyanops, Ramsay, Proc. Linn. Soc. N.S. Wales, ii. (2nd ser.) p.678, 1887; Ramsay, p.38; North, 'Nests and Eggs,' p.379; North, 'Lord Howe Island,' p.48.

Hab.—Lord Howe and Norfolk Islands. (N. Australia, S. Tropical Oceans).

The Masked Gannet breeds in fairly large numbers on the Admiralty Islets off Lord Howe Island, and on Nepean and Phillip Islands, and the smaller rocky islets off Norfolk Island. The season extends from early in September until January, but in the majority of cases October is the month for laying. Except in a few isolated instances, the nests contained two eggs during the seasons of 1907 and 1908, but this bird appears to make family arrangements in accordance with the food-supply. On the Admiralty Islet, which I visited in 1907, of the nests examined one contained three fresh eggs, twenty contained two in varying stages, and one contained one fresh egg which was probably an uncompleted sitting, as it was quite clean. I found no nests containing young birds on this occasion (16th October). In 1908, I found two nests on Nepean Island, each containing a fresh egg, one containing two eggs half incubated, and one containing two eggs just chipping (15th October). On the 3rd November, 1908, I visited Phillip Island and examined about twenty nests, taking eleven clutches of eggs. The following table showing their condition is interesting.

No. of Clutch.	No. of Eggs.	Condition.
1	2	1. Fresh, but slight tinge of blood in yolk. 2. Slightly incubated, considerable blood in yolk, and albumen thickening.
2	2	Both addled, contents thin, watery and offensive. (The bird was sitting).
3	2	Both nearly hatched.
4	2	1. One-fourth incubated, legs formed. 2. Slightly incubated, legs not formed.
5	2	1. About one-third incubated. 2. Slightly incubated, but embryo dead.
6	2	Both about half incubated; legs and wings formed.
7	2	About one-fourth incubated.
8	2	1. Nearly hatched. 2. Slightly incubated; embryo dead.
9	2	1. Addled, thin, watery. 2. Addled, thin, watery, very offensive. (No.2 was lying outside the nest).
10	2	1. About half incubated. 2. Rather more advanced than 1.
11	1	Addled, thin, watery.

The other nests contained young birds in varying stages, from just hatched, "naked and unashamed," to the beautiful mass of snowy white down of a bird three weeks old. In two cases there were two living birds, just hatched, in the nest; and in one case there was one living bird, just hatched, in the nest, and a dead one was lying on a heap of twigs near the nest. In all the other cases there was only one young bird.

The conclusion I have ventured to draw from these facts is, that, in this particular season and locality, the Gannets deliberately limited their family to one, either by neglecting one of the eggs, and allowing it to get cold, or pushing it out of the nest; or, where both eggs hatched out, by ejecting one of the young birds and allowing it to die from cold and starvation.*

The parent-birds appeared to have no immediate lack of food, as in each case upon my approach the sitting bird vomited up a "wad" of comparatively fresh fish of the mackerel genus, packed together with the heads all in one direction, and covered with greyish slime. One of these wads, which I inspected closely, consisted of six fresh fish about six inches in length.

Mr. Tom Iredale informs me that on the Kermadec Islands this Gannet lays from one to *five* eggs.

The nest is generally placed in an elevated position commanding a good outlook, but a few were close to the shore on a sloping ridge, placed amongst tussocks of Moöo grass. Where the soil was soft, a slight depression was made, and a few straws or rushes laid therein. On the harder ground a slight ridge of pebbles or small lumps of clay was raked up round the eggs.

When first laid the eggs are covered with a soft white chalky substance, which can easily be removed by scraping, disclosing a shell of a delicate pale bluish tint. The soft coating rapidly absorbs colour from the soil upon which it is laid, and, owing to its being frequently turned by the sitting bird, this added colour is most intense round the thickest part of the egg. Specimens taken from the clayey soil of the Admiralty Islets are from dirty white to blackish-brown, while some of those taken from the brilliant red soil of Phillip Island range from ochraceous to deep orange-red.

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* In their article on the Birds of Clipperton and Cocos Islands (vide p.662) Snodgrass and Heller give the following note:—"On Clipperton this bird [*S. cyanops*] was found breeding in immense numbers in November," [the Island was visited on 23rd and 24th November, 1898]. The nests consisted of slight depressions scraped in the coral sand and contained one or two eggs each. The nesting had just begun, for no incubated eggs or young birds were seen. A set generally consisted of two eggs, but we were assured by people living on the island that only one young bird of each pair is reared, the other being left by its parents to starve on account of the extreme voracity of the young."(*op. cit.* p.512).

In dimensions the eggs vary to a great extent, and the eggs of a clutch are seldom of the same size.

Dimensions of five selected clutches:—

(1)*a*, 2·45 × 1·8; *b*, 2·6 × 1·85; *c*, 2·6 × 1·74(Admiralty Islet, 16th Oct., 1907).

(2)*a*, 2·75 × 1·95; *b*, 2·85 × 1·8(Admiralty Islet, 16th Oct., 1907).

(3)*a*, 2·5 × 1·84; *b*, 2·55 × 1·8(Phillip Island, 3rd Nov., 1908).

(4)*a*, 2·8 × 1·9; *b*, 2·6 × 1·8(Phillip Island, 3rd Nov., 1908).

(5)*a*, 2·6 × 1·8; *b*, 2·2 × 1·74(Phillip Island, 3rd Nov., 1908).

(Specimen *b*, of clutch 5, was lying outside the nest, addled).

248(M). 38. FREGATA ARIEL Gould.

Lesser Frigate Bird.

Attagen ariel, Etheridge, 'Lord Howe Island,' p.16.

Hab.—Lord Howe Island(visitor only). (Australian Seas, Tropical and Sub-Tropical Oceans).

250(M). 39. PHAËTHON ERUBESCENS Rothsch.

Roseate Red-tailed Tropic Bird; Bosun Bird(L.H.I.); Tropic Bird (N.I.).

Phaeton rubricauda, Bodd.; Crowfoot, p.268; Ramsay, p.38; North, 'Nests and Eggs,' p. 378; North, 'Lord Howe Island,' p. 47; Etheridge, 'Lord Howe Island,' p.16.

Hab.—Lord Howe and Norfolk Islands. (Laysan Island, Kermadec Islands).

This variety of the Tropic Bird is distinguished by a rosy tinge, which fades from the feathers unless kept from the light. It breeds in considerable numbers on the almost inaccessible cliffs of both groups. On the occasion of my visit to Phillip Island (3rd November, 1908), the birds were commencing to select their nesting places. From the top of the Peak I looked down a sheer cliff, 900 feet to the ocean, and saw these magnificent birds in hundreds sailing and wheeling about in their stately manner, with the scarlet tail-feathers streaming behind their glossy white bodies, while they filled the air with their cry of "Honk, Honk," resembling that of the Solan Goose. A few birds were sitting in the crevices in pairs.

Mr. Lindsay Buffett informed me that on Phillip Island this bird lays one egg only on a ledge, in a crevice, or on the sand under an overhanging boulder, from the base to the top of the cliff. It is possible to reach some of the eggs by standing up in a boat brought in to the base of the cliff in very calm weather. Very few birds breed on Nepean Island and the smaller rocky islets.

On Lord Howe Island it breeds on the cliffs of the main island.

The breeding season at both groups extends from the end of November to the end of January. I have specimens of eggs taken at Lord Howe Island during December and January, 1908-9. They are very handsome, and variable in colour-markings. The ground-colour is white, but most examples are so heavily marked with purplish-pink specks and spots, with overlying purplish-brown blotches that the ground-colour is entirely obscured. Very occasionally, white specimens are obtained. North mentions two of the latter as being obtained at Lord Howe Island.

Dimensions :—(1) 2·7 × 1·98 (15th December, 1907); (2) 2·7 × 1·9 (14th December, 1908); (3) 2·6 × 1·85 (18th January, 1909); (4) 2·55 × 1·8 (31st January, 1909).

251(M). 40. PHAËTHON LEPTURUS Daudin.

White-tailed Tropic Bird.

Phaeton candidus, North, Rec. Aust. Mus. iii., No. 4, p. 89 (1898).

Hab.—Lord Howe Island (visitor). (Australian Seas, Tropical Oceans, Atlantic and Pacific Oceans).

One specimen in an advanced stage of immaturity was obtained from Lord Howe Island in May, 1890, by Mr. D. Love (North).

ACCIPITRIFORMES.

253(M). 41. CIRCUS GOULDI Bonaparte.

Gould's Harrier; Hawk (L.H.I., and N.I.)

Circus gouldi, Ramsay, p. 37; *C. wolfii*, Etheridge, 'Lord Howe Island,' p. 8.

Hab.—Lord Howe and Norfolk Islands (visitor only). (Australia generally, Tasmania, New Zealand, New Caledonia, Fiji Is.).

256(M). 42. ASTUR NOVÆ-HOLLANDIÆ Gmelin.

White Goshawk.

Hab.—Lord Howe Island (visitor only). (Queensland, New South Wales, Victoria, Tasmania, S. Australia).

Mr. Herbert Wilson, of Lord Howe Island, described to me a bird which was evidently the White Goshawk. It visited the island on one occasion only, remaining there for some time.

265(M). 43. HALIAËTUS LEUCOGASTER Gmelin.

White-bellied Sea-Eagle.

Haliaëtus leucogaster, Ramsay, p.37.

Hab.—Lord Howe Island (visitor only). (Australia generally, Tasmania, Malay Archipelago to India and Ceylon).

267(M). 44. HALIASTUR SPHENURUS Vieillot.

Whistling Eagle.

Haliastur sphenurus, Ramsay, p.37.

Hab.—Lord Howe Island (visitor only). (Australia generally, New Caledonia, New Guinea).

STRIGIFORMES.

284(M). 45. NINOX ALBARIA Ramsay.

Lord Howe Island Owl; Morepork (L.H.I.).

Ninox albaria, Ramsay, p.37 (note).

Hab.—Lord Howe Island.

In his Tabular List, Ramsay places this species in the column devoted to the birds of Norfolk Island, but in the note describes it as from Lord Howe Island.

I frequently heard the cry of this bird at night, but did not see it. The cry resembles that of *Ninox boobook*.

283(M). 46. NINOX BOOBOOK Latham.

Boobook Owl.

Ninox boobook, Ramsay, p.37.

Hab.—Norfolk Island. (Australia generally, Tasmania).

Ramsay says: "The Norfolk Island bird is said to be *Ninox boobook*, but it is more likely to prove to be *Ninox novæ-zealandiæ*, or perhaps the present species" [*N. albaria*].

I did not see or hear this bird at Norfolk Island, but was informed that it still exists in the gullies on Mount Pitt.

PSITTACIFORMES.

299(M). 47. NESTOR PRODUCTUS Gould.

Phillip Island Parrot.

Nestor productus, Ramsay, p.38.

Hab.—Phillip Island(extinct).

300(M). 48. NESTOR NORFOLCENSIS Pelzeln.

Norfolk Island Parrot.

Hab.—Norfolk Island(extinct).

334(M). 49. PLATYCERCUS ELEGANS Gmelin.

Pennant's Parrakeet; Red Parrot(N.I.).

Platycercus pennanti, Ramsay, p.37; var. *Nobbsi* Tristram, Ibis, iii.,(5th Ser.)p 48(1885).

Hab.—Norfolk Island. (S. Queensland, New South Wales, Victoria, S. Australia).

Pennant's Parrakeet is found in very large numbers at Norfolk Island, feeding in pairs or small flocks along the roadside, or in the cultivation-paddocks. It also evinces a partiality for the orchards when the fruit is ripening, and, generally speaking, is most destructive in field, orchard, or strawberry garden.

Being a mainland species, it is rather curious that this bird has not settled at Lord Howe Island also.

It lays from five to eight eggs in a spout or hollow of a dead tree. They are dull white, rounded in form. Dimensions: 1·08 × 0·88.(N.I., 10th Oct., 1908).

369(M). 50. CYANORHAMPHUS COOKI Gray.

Norfolk Island Parrakeet; Green Parrot(N.I.).

Cyanorhamphus cooki (non *rayneri*), North, Proc. Linn. Soc.N.S.Wales, viii, p.517.

Hab.—Norfolk Island.

This graceful Parrakeet is now becoming so scarce at Norfolk Island that the Chief Magistrate (Captain Elliott, R.N.) issued a notification protecting it from destruction unless caught, *in flagrante delicto*, damaging the fruit-crops. It is now almost entirely restricted to the gullies running up towards the top of Mount Pitt.

While at Norfolk Island I did not succeed in finding any nests, but at Palm Glen, the residence of Mr. Alfred Waterhouse, on a spur of Mount Pitt, I saw several birds, and was informed that they breed in hollows of dead trees, generally at a considerable height from the ground.

Eggs, clutch two, creamy white, surface dull. Two eggs taken on the 12th of October, 1902, presented to me by Dr. Metcalfe, differ remarkably in size, the dimensions being: (*a*). 1·11 × 0·9; (*b*) 0·88 × 0·78.

I have also a single egg, taken at Mount Pitt, on the 28th of February, 1909, measuring 1·15 × 0·97.

370(M). 51. CYANORHAMPHUS SUBFLAVESCENS Salvadori.

Lord Howe Island Parrakeet.

Platycercus sp., Etheridge, 'Lord Howe Island,' p.10.

Hab.—Lord Howe Island(extinct).

Mrs. Nichols informed me that, some years ago, this Parrakeet was very plentiful, but, being destructive in the fruit-gardens, it was gradually exterminated.

CORACIIFORMES.

381(M). 52. EURYSTOMUS PACIFICUS Latham.

Dollar-bird or Roller.

Eurystomus pacificus, Ramsay, p.37.

Hab.—Lord Howe and Norfolk Islands (visitor only). (Australia, except S. and W., New Zealand, Molucca Is., Celebes, Lesser Sunda Is.).

This bird is a very occasional visitor to both islands. I did not see one on my visits, but was informed by residents in both islands that it had been seen and shot occasionally. A specimen was shot at Lord Howe Island by Mr. L. Waterhouse, in 1903.

393(M). 53. HALCYON VAGANS Lesson.

Norfolk Island Kingfisher; Kingfisher(L.H.I.); Norfolker (Noffka: N.I.).

Hab.—Lord Howe and Norfolk Islands. (New Zealand).

This bird is found in large numbers on both islands. At Norfolk Island it breeds in holes tunnelled in the clayey or sandy banks. On the sides of the main road and quite close to the township, Kingston, many hundreds of holes may be seen, some partly excavated and abandoned on account of the hardness of the ground, some used and deserted, and others in actual use during the breeding season (September to December). In one bank, which consisted of a mixture of sand and clay and was, therefore, peculiarly suitable for boring, I counted no less than 40 holes in a space of 6 by 4 feet. Less frequently it breeds in the gigantic tree-ferns, or in decayed portions of the Norfolk Island Pine(*Araucaria excelsa*).

At Lord Howe Island this bird breeds only in the decayed portions or hollow spouts of the huge Banyan tree(*Ficus* sp.).

At the latter island the Kingfisher bears a bad reputation, it being asserted that it kills chickens out of pure mischief, and not for food. It is, therefore, generally shot when it approaches too close to the fowl-yard. At Norfolk Island it is regarded as quite harmless, and is even held in affectionate regard. Its local name was given to it by the Pitcairn Islanders when they settled on the island. There being no similar species at "Home"(Pitcairn), they called this bright stranger the "Norfolker," which is now shortened to "Noffka."

Eggs, clutch 4 to 6, pearly white, glossy, varying from roundish to slightly pointed ovals. Dimensions of a clutch of five—(*a*)1·08 × 0·88; (*b*)1·02 × 0·85; (*c*)1·08 × 0·85; (*d*)1·08 × 0·84; (*e*) 1·02 × 0·86. (Norfolk Island, 7th November, 1908).

COCCYGES.

405(M). 54. Cuculus inornatus Vigors & Horsfield.

Pallid Cuckoo.

Cacomantis pallidus Latham; Ramsay, p.37.

Hab.—Lord Howe Island (visitor only). (Australia generally, Tasmania).

406(M). 55. Cacomantis rufulus Vieillot.

Fan-tailed Cuckoo.

Cacomantis flabelliformis Latham; Ramsay, p.37.

Hab.—Lord Howe Island (visitor only). (Australia generally, Tasmania, Aru Is.).

411(M). 56. Chalcococcyx lucidus Gmelin.

Broad-billed Bronze Cuckoo; Greenback(N.I.).

Chalcites plagosus Latham; Ramsay, p.37.

Hab.—Lord Howe Island, Norfolk Island. (E. Australia, Tasmania, New Zealand, Chatham Is., Macquarie Is.).

This Cuckoo is by no means common on either island, and, so far as I could ascertain, it has no local name at Lord Howe Island. I have not heard of its breeding at the latter island, but an egg was taken by Dr. Metcalfe in the nest of *Pseudogerygone modesta* at Norfolk Island. I saw one bird only there, but a correspondent, writing under date 8th August, 1909, stated that several flocks of "greenbacks" had just arrived.

415*a*(M). 57. Eudynamis taitensis Sparrm.

Long-tailed Cuckoo; Sparrow Hawk, or Home Owl(N.I.).

Eudynamys taitensis, Ramsay, p.37.

Hab.—Lord Howe (accidental), and Norfolk Island. (New Zealand, Ellice Is., Tahiti).

The Long-tailed Cuckoo is very common at Norfolk Island during the spring and summer months, and its shrill cry is frequently heard about dusk. The local residents regard it as a bird of prey, hence its name of "Sparrow Hawk," on account of its habit of stealing both eggs and young of the small native birds. The name "Home Owl," given it by some of the Pitcairners, refers to its habitat extending to their old home, Pitcairn Island. The term "Owl" no doubt refers to its semi-nocturnal habit.

Although there is no recorded instance of an egg of this Cuckoo being found at Norfolk Island, and Dr. Metcalfe considers that it does not lay there, I anticipate that it will yet be found to place its egg in the nest of the local *Pseudogerygone*.

Dr. Robert Fulton, of Dunedin, N.Z., has dealt very fully with the habits of this Cuckoo,* and has ably summarised the evidence as to its foster parents in New Zealand, and the descriptions of its egg. The latter is said to be variable in coloration and markings, being white when laid in domed or covered-in nests, and marked somewhat in imitation of the eggs of its more or less unwilling hosts. So far as can be gathered from the available data, the question of a satisfactory description of the egg has not been settled. The dimensions are given as varying from 0·75 to 1·25 inch in length, and the shape from almost spherical to ovoido-elliptical.

A specimen of this bird was shot at Lord Howe Island in 1905, and the skin is now in the possession of Mr. John Waterhouse, of Chatswood.

PASSERIFORMES.

429(M). 58. HIRUNDO NEOXENA Gould.

House Swallow.

Hab.—Lord Howe Island (accidental). (Australia generally, Tasmania).

A single bird arrived at Lord Howe Island on the same day as myself. It remained there during my stay on the Island, perching on the porch of Mrs. Nichols' residence, from whence it pursued insects with vigour. Mrs. Nichols informed me that it did not remain long after I left.

* Trans. N. Z. Inst. xxxvi. p.113, 1903(1904); Report Aust. Assoc. Adv. Sci., 1904, x., 513.

441(M). 59 PETRŒCA MULTICOLOR Gmelin.

Norfolk Island Robin; Robin(N.I.).

Petrœca erythrogastra Gould, p.526; *Petrœca multicolor*, Ramsay, p.37; North, 'Nest and Eggs,' p.410.

Hab.—Norfolk Island.

This species, peculiar to Norfolk Island, is common in the timber near cultivation, the bright colour of the male being very conspicuous as he perches on the stumps or low branches of the shrubs. The nest is similar to that of *P. leggii*, but somewhat larger, deeper, and more warmly lined with fine cowhair, thistle-down, or other soft material. Outwardly it is constructed of mosses, ornamented with bright green lichens. It is generally placed in an upright fork at any convenient point, from a few feet from the ground to the topmost twigs of a tree fifty feet in height. Two nests taken for me were in very high whitewood trees, and another was placed on the horizontal branch of a Norfolk Island pine. The breeding season commences in September, and extends over the two following months. Eggs, clutch two generally, occasionally three(North, three or four). Oval in form, greyish or greenish ground, freckled, spotted or blotched with warm brown over the whole shell, but more thickly at the larger end, where the markings occasionally become confluent and form a cap or zone.

Dimensions:

(1) *a*, 0·74 × 0·59; *b*, 0·75 × 0·58; *c*, 0·77 × 0·58(21st Oct., 1908).
(2) *a*, 0·75 × 0·60; *b*, 0·74 × 0·59(22nd Oct., 1908).
(3) *a*, 0·84 × 0·61; *b*, 0·77 × 0·61(11th Nov., 1908).

453(M). 60. GERYGONE THORPEI Ramsay.

Rain-bird, or Pop-goes-the-Weasel(L.H.I.).

Gerygone thorpei Ramsay, Proc. Linn. Soc. N. S. Wales, ii.(2nd Ser.), p.677(1887); Etheridge, 'Lord Howe Island,' p.9.

Hab.—Lord Howe Island.

The residents do not distinguish this species from *Pseudogerygone insularis*, but it is a smaller bird, and may be easily recognised by its yellow breast.

I did not succeed in finding a nest of this bird.

454(M). 61. PSEUDOGERYGONE MODESTA Pelzeln.

Ashy-fronted Gerygone; Humming Bird (N.I.).

Gerygone modesta, Ramsay, p.37; North, 'Nests and Eggs,' p.410.

Hab.—Norfolk Island.

The Norfolk Island Gerygone is a busy little insect-hunter, all day long merrily trilling his chromatic scales in the more open timbered country, and in the gardens of the residents. The nest is similar in shape to that of *G. albigularis* of the mainland, constructed of bark, grass, cowhair, wool, or any other soft material handy; domed, and with a short protecting hood above the entrance, lined with feathers, and suspended to a wild tobacco twig, or amongst the dense leaves of the bloodwood. One nest I examined was constructed almost entirely of wool gathered from the barbed-wire fences, bound together with long grasses and horsehair. The lining contained only two or three feathers. The regular breeding season extends from September to December, but a nest containing three fresh eggs was taken on the 20th February, 1909.

Eggs, clutch two to three (North, two to four), elongated oval, varying from white to pale pinkish, finely spotted with dark red or streaked, spotted, or blotched with pale red, generally well distributed over the whole shell, but occasionally forming a cap or zone at the larger end.

Dimensions :

(1) *a*, 0·63 × 0·50; *b*, 0·67 × 0·51; *c*, 0·64 × 0·50 (9th Nov. 1908).
(2) *a*, 0·73 × 0·50; *b*, 0·72 × 0·52; *c*, 0·73 × 0·52 (29th Nov. 1908).
(3) *a*, 0·68 × 0·50; *b*, 0·67 × 0·50 (12th Nov., 1908).

458(M). 62. PSEUDOGERYGONE INSULARIS Ramsay.

Rain-bird, or Pop-goes-the-Weasel (L.H.I.).

Gerygone insularis Ramsay, Proc. Linn. Soc. N. S. Wales, iii., p.117 (1878); Etheridge, 'Lord Howe Island,' p.9.

Hab.—Lord Howe Island.

The sweetly mournful note of this bird somewhat resembles that of *Gerygone albigularis*, in that it is chromatic, but it is more staccato and varied in its tones. By some of the Islanders it is called "Pop-goes-the-Weasel," it being considered that its song resembles that ancient air. The birds are fairly numerous, flying briskly about the tree-tops; and are especially active in the pursuit of small insects after a shower of rain.

I did not succeed in finding a nest of this bird, but it was described to me by the islanders as being a dome-shaped structure, with entrance at the side, having a projecting hood.

481(M). 63. RHIPIDURA PELZELNI Gray.

Pelzeln's Fantail; Fantail (N.I.)

Rhipidura pelzelni, Ramsay, p.37; North, 'Nests and Eggs,' p.409.

Hab.—Norfolk Island.

This confiding little Fantail is closely allied to the Lord Howe Island species, and its nest is similarly constructed with either a very rudimentary "tail," or with none at all. It is placed in the fork of a wild tobacco plant, often quite close to the ground, or on a horizontal twig of a "currajong" tree, or amongst the thick leaves of one of the lower branches of a bloodwood tree. It is constructed of tufts of short cowhair, mosses, &c., woven together, and outwardly covered with cobweb ornamented with splinters of decayed pine, lined with long tail-hairs of horse or cow.

The bird is very familiar, and will hover round one's head, or pick a fly from the face or hand of a recumbent person.

Eggs, clutch two to three (North, on the authority of Dr. Metcalfe, three or four), short oval in form, white, glossy, with pale yellow-brown markings, and suffused bluish-grey blotches and spots, scattered over the whole shell, or forming a cap or zone at the larger end.

Dimensions:

(1) *a*, 0·65 × 0·50; *b*, 0·64 × 0·50; *c*, 0·62 × 0·50 (16th November, 1908).
(2) *a*, 0·62 × 0·50; *b*, 0·62 × 0·47; *c*, 0·60 × 0·50 (21st October, 1908).
(3) *a*, 0·63 × 0·50; *b*, 0·64 × 0·50; *c*, 0·63 × 0·50 (1st November, 1908).

482(M). 64. RHIPIDURA MACGILLIVRAYI Sharpe.

Fawn-breasted Fantail; Fantail(L.H.I.).

Rhipidura macgillivrayi Sharpe, Proc. Zool. Soc. 1881, p.789; *Rhipidura cervina* Ramsay, Proc. Linn. Soc. N. S. Wales, iii. p.340(1878); Etheridge, 'Lord Howe Island,' p.9.

Hab.—Lord Howe Island.

On my arrival at Lord Howe Island, 3rd October, 1907, Mr. J. B. Waterhouse informed me that he had found a Fantail's nest near his house. On the following day I visited the spot, and was shown a nest which the birds had built a few weeks previously, but abandoned on completion. It was placed on a horizontal twig of a small tree, about fifteen feet from the ground. A fresh nesting-place had been chosen in a small prickly shrub, overgrown with clematis, the nest being almost hidden amongst the vine-leaves, securely fastened in the fork of a small branch of the shrub. The female was sitting, and reluctantly slipped off at our approach. The nest contained two eggs, and, thinking that the full complement had not been laid, I left it until the 8th October. The female was still sitting on that date, but no more eggs had been added to the original two, which were found to be slightly advanced in incubation.

This Fantail is very tame, and fond of frequenting the vicinity of dwellings, where it will often enter the kitchen and capture flies from the walls.

On the 11th October, I saw a pair of birds feeding two young ones, fully fledged, and able to fly.

The nest and eggs are here described for the first time.

Nest, somewhat similar to that of *Rhipidura albiscapa*, wine-glass shaped, without "foot," but with a very rudimentary "stem" or tail, composed of decayed wood, fibre from the sheaths of the Kentia palm-fronds, and fine grass, outwardly matted and bound together with spiders' webs, lined with fine grass; placed on a horizontal or forked twig, from 3 to 15 feet from the ground, in the scrubby thickets. Dimensions: 2 inches in width by 3 inches (including tail) in depth; egg-cavity, $1\frac{3}{4}$ inches in width by 1 inch in depth.

Eggs, clutch two; short oval in shape; texture of shell fine, surface somewhat glossy; colour creamy white, spotted or streaked (a) all over the shell, (b) on the upper quarter only, with pale brown and suffused slate markings, larger and forming a cap at the upper end. Dimensions: (*a*) 0·65 × 0·51; (*b*) 0·65 × 0·50.

488(M). 65. MYIAGRA RUBECULA Latham.

Leaden Fly-catcher.

Myiagra rubecula, Ramsay, p.37. (Australia generally, Tasmania, S.E. New Guinea).

Hab.—Lord Howe Island (doubtful).

504(M). 66. CORACINA ROBUSTA Lath.

Black-faced Cuckoo Shrike; Blue Jay (L.H.I.).

Hab.—Lord Howe Island (visitor only). (Australia generally, New Zealand, *accid.*, New Guinea, Celebes, Molucca Is.).

A somewhat frequent visitor from the mainland, not elsewhere recorded.

512(M). 67. DIAPHOROPTERUS LEUCOPYGIUS Gould.

Sparrow (N.I.).

Symmorphus leucopygius, North, 'Nests and Eggs,' p.408.

Hab.—Norfolk Island.

This is one of the species peculiar to Norfolk Island, where it is found in considerable numbers. A bright and lively little bird, in general appearance it closely resembles *Lalage tricolor*, but it is smaller. In its habits, flight, and manner of catching insects on the wing it is very like *Micrœca fascinans*. It perches on stumps or fences, from which it pounces on ground-insects, or flying upwards, takes others on the wing. Owing to its habit of collecting an early breakfast amongst the dew-drenched grass, its otherwise snow-white breast becomes discoloured with the reddish dust which settled on the grass-blades overnight. Its chief note is a single harsh chirp, like the first or last staccato notes of a cicada.

Dr. Metcalfe gives September as the regular breeding month of this species (North). I was not fortunate enough to find any nests with eggs, but during the month of November found two containing young birds. These nests were both built in introduced pine-trees growing close to a residence, and were open cup-shaped structures of moss, larger and more substantial than the nest of *Lalage tricolor*. I have since received two clutches of eggs, both taken in the township of Kingston, on the 20th February, 1909. The months of November and December, 1908, were exceptionally wet, and many of the land-birds took advantage of the abundant food-supply, and bred again from January to March, 1909.

Eggs, clutch two, occasionally three. Pale green ground-colour, slightly tinged with grey, with thick, irregularly shaped, longitudinal markings of different shades of olive-brown, and a few minute freckles scattered over the surface of the shell; on the larger end several obsolete markings of dull bluish-grey appear. Dimensions: 0·88 × 0·67(North).

(1)*a*,0·9 × 0·66; *b*,0·86 × 0·66(20th February, 1909).

(2)*a* and *b*,0·87 × 0·67(20th February, 1909).

(3)*a*,0 92 × 0·66; *b*,0·82 × 0·66; *c* was broken, but was intermediate between *a* and *b*(11th December, 1908).

540(M). 68. Merula vinitincta Gould.

Vinous-tinted Ouzel; Doctor Bird(L.H.I.).

Merula vinitincta Gould, p.59; Ramsay, p.37; North, 'Nests and Eggs,' p.412; Seebohm, Mon. Turdidæ, ii., p.137(1902).

Hab.—Lord Howe Island.

A very common and exceedingly tame species, peculiar to Lord Howe Island, the "Doctor Bird" is seen everywhere, scratching amongst the dead leaves with the industry of a barnyard fowl, or perched on the low shrubs, emitting its sharp whistling chirp. Its local name is said to be derived from a sharp double knocking sound uttered when the bird is alarmed. Though so tame that one can approach quietly within a few feet, any sudden appearance of a human being, or a loud noise, will send it scolding away for a short flight, but it soon stops to reconnoitre, curiously watching the intruder. It is also very suspicious, and will desert a nest either when building, with eggs, or even with young birds, if touched by a human hand.

The nest is a large loosely built structure, open, shallow, cup-shaped, outwardly of woven fibre from the sheaths of palm-fronds, and dead leaves, lined with dry grasses, placed at the foot of a palm amid the dead fallen fronds, on top of a stump, or in a mass of intergrown vines a few feet from the ground.

Eggs, clutch two, inclining to elongated-oval in form, slightly pointed at the thinner end, of a pale greenish-grey ground-colour, with freckles, dots, and horizontal markings of reddish-brown dispersed over the entire surface of the shell; in some places a few nearly obsolete blotches of purplish-grey appear. These eggs vary considerably in size and shape, some being short rounded ovals, and others long and pointed. The ground-colour varies from a distinct green to pale greyish, and the markings from bright red to dull purplish-red.

Dimensions:

(1)*a*, 1·21 × 0·81; *b*, 1·22 × 0·80 (18th October, 1907).
(2)*a*, 1·07 × 0·78; *b*, 1·10 × 0·80 (18th November, 1908).
(North)*a*, 1·15 × 0·77; *b*, 1·12 × 0·77.

541 (M). 69. MERULA FULIGINOSA Latham.

Norfolk Island Ouzel; Guava Bird (N.I.).

Merula poliocephala Gould, p.528; Ramsay, p.37; North, 'Nests and Eggs, p.411; Seebohm, Mon. Turdidæ, ii., p.91 (1902).

Hab.—Norfolk Island.

The Norfolk Island Ouzel differs from the Lord Howe Island species in the colour of the head and neck, which are greyish in the adult bird. In habits and general characteristics it closely resembles *M. vinitincta*. The nest is also similar in size, shape and materials, but it is most frequently placed in a tree or shrub at a height of from six to twenty feet from the ground. A favourite position is amongst the matted thorny branches of the lemon tree, which has run wild and is found all over the Island.

Dr. Metcalfe informed me that this bird has two breeding seasons, (1) August to December, (2) March to May. During the latter season it lays four eggs, while two form the complement during the spring and summer breeding. The local name is said to be derived from the bird's habit of eating ripe guavas.

Eggs, colour and markings similar to those of *M. vinitincta*, but the average dimensions are slightly larger; three from different nests measured by North were (*a*) 1·18 × 0·83; (*b*) 1·21 × 0·82; (*c*) 1·19 × 0·8. Those in my collection measure:

(1) *a*, 1·11 × 0·86; *b*, 1·18 × 0·85(13th Oct., 1908).
(2) *a*, 1·13 × 0·85; *b*, 1·21 × 0·83(11th Oct., 1908).
(3) *a*, 1 26 × 0·84; *b*, 1·12 × 0·83(1st Dec., 1908).
(4) *a*, 1·12 × 0·88; *b*, 1·23 × 0·84(1st Dec., 1908).
(5) *a*, 1 × 0·76; *b*, 1 × 0·74(25th Dec., 1908.) This set is abnormally small, pale blue, with very faint markings,

646(M). 70. GRALLINA PICATA Latham.

Magpie Lark.

Hab.—Lord Howe Island(visitor only.) (Australia generally, Tasmania).

This bird, I was informed by several inhabitants, is a by no means infrequent visitor at Lord Howe Island. It has not been recorded elsewhere as a visitor to this Island.

668(M). 71. PACHYCEPHALA CONTEMPTA Hartert.

Lord Howe Thickhead; Robin, or Yellow Robin (L.H.I.).

Pachycephala gutturalis, Ramsay, p.37; Etheridge, 'Lord Howe Island,' p.9.

Pachycephala contempta Hartert, B.O.C. viii., p.xv.(1898).

Pachycephala howensis, North, Rec. Aust. Mus., v, p.125(1903).

Hab.—Lord Howe Island.

The Australian Museum Memoir on Lord Howe Island follows Dr. Ramsay in identifying the Lord Howe Thickhead with *P. gutturalis* (*pectoralis*) of Latham. In 1903, North, having examined a series of skins, says "This species is closely allied to *Pachycephala gutturalis* Latham, of the Australian continent, but from which the adult male may be distinguished by the olive-green tail, and the smaller and less distinct subterminal blackish-brown band. In some specimens the band is formed by a large oval spot in the centre of the web only, and which is entirely lost on the outermost feathers."

The notes of this Thickhead are heard in the lowlying scrubs and thickets of the settled part of the Island from "early morn till dewy eve," and even late into the night. It has one frequently repeated note resembling the words "Seed wheat," with a sharp rising inflexion on the latter syllable.

I was fortunate enough to find a nest and eggs of this species, hitherto undescribed, when strolling through the palm-glens, in company with Mr. J. B. Waterhouse.

The nest is an open cup-shaped structure, composed of strips of the inner sheathing of Kentia palm-fronds and vine-tendrils, lined with coarse dried grass, placed on a matted base of skeleton leaves, in a shrub thickly overgrown with lawyer-vines, about eight feet from the ground. Dimensions: 6 inches in width by $2\frac{1}{2}$ inches in depth; egg-cavity, $2\frac{3}{4}$ inches in width by $1\frac{1}{4}$ inches in depth.

Eggs, clutch two; oval in shape; texture of shell fine, surface glossy; colour white, spotted with small blackish-brown freckles sparsely distributed over the whole shell, and with large spots or blotches of sepia, and suffused greyish or slate blotches forming a distinct zone round the upper quarter. Dimensions : (*a*) $0{\cdot}94 \times 0{\cdot}7$; (*b*) $0{\cdot}94 \times 0{\cdot}69$ inch. These eggs very closely resemble the pearly white ground type of *P. pectoralis*.

678(M). 72. PACHYCEPHALA XANTHOPROCTA Gould.

Norfolk Island Thickhead; Tamey (N. I.).

Pachycephala xanthoprocta, North, 'Nests and Eggs,' p. 409.

Hab.—Norfolk Island.

The Norfolk Island Thickhead is a very plain and sad-coloured bird, both sexes being alike in plumage. It is so remarkably tame that, even in that island-paradise of fearless birds, it has earned the local name of "Tamey." Its rich, liquid notes may be heard in every patch of scrub, and any human being visiting its haunts is at once spied out and inspected with deep interest and curiosity. A pair of birds will hop on to the branches nearest the visitor's head, and with bright eyes full of questioning, each bird, uttering short interrogatory notes with head turned first to one side and then to the other, will accompany the intruder for some distance until its curiosity is satisfied.

The nest is characteristic of the genus, being an open cup-shaped structure of rootlets, lined with grass, rather larger and more loosely put together than that of *P. pectoralis*, and frequently supported on a mass of skeleton leaves. It is placed at no great height in "currajong," lemon, and other small trees, or in hanging masses of vines.

Eggs, clutch generally two, occasionally three (three to four, North, on the authority of Dr. Metcalfe). Elongated-oval, creamy to buffy-white ground, with spots and freckles of dark brown; or pale brown ground, with blotches and spots of rich brown, either scattered over the whole shell or forming a distinct zone at the larger end. They vary slightly in size and shape, and are generally of an elongated form.

Dimensions :

(1) *a*, 1·02 × 0·75; *b*, 1·02 × 0·72; *c*, 1·01 × 0·72(6th Nov. 1908).
(2) *a*, 1·05 × 0·70; (*b*), 1·05 × 0·72(5th Nov. 1908).

712(M). 73. ZOSTEROPS CÆRULESCENS Latham.

Silver-eye; Little Grinnell(N.I.).

Zosterops lateralis, North, Rec. Aust. Mus. v. p.337(1904).

Hab.—Norfolk Island. (E. and S. Australia, New Zealand).

This Australian species has, of recent years, taken up its abode in Norfolk Island, probably coming by way of New Zealand, as it is not found at Lord Howe Island.

715(M). 74. ZOSTEROPS TEPHROPLEURA Gould.

Grey-breasted Silver-eye; Little Silver-eye(L.H.I.).

Zosterops tephropleurus Gould, p.538; Ramsay, p.37; Etheridge, 'Lord Howe Island,' p.9.

Hab.—Lord Howe Island.

This is a smaller and less striking bird than *Z. strenua*, resembling *Z. cærulescens* of Australia. I did not find its nest.

718(M). 75. ZOSTEROPS STRENUA Gould.

Robust Silver-eye; Big Silver-eye (L.H.I.).

Zosterops strenuus Gould, p.537; Ramsay, p.37; Etheridge, 'Lord Howe Island,' p.9.

Hab.—Lord Howe Island.

This very fine and large species of Zosterops is found in great numbers at Lord Howe Island, where its powerful song makes music all day long in the palm-glades and on the wooded hillsides. Its nest is large, loosely constructed, and cup-shaped, composed outwardly of palm-fibre, woven with dried grasses and lined with finer material of the same kind, placed amongst the masses of fibre clothing the under side of the crown of the Kentia palms; or in shrubs overgrown with vines. During October, 1907, I found a large number of old nests, many blown down and lying on the ground, but none containing eggs or young birds.* Dimensions : 4 to 5 inches in width by 2 inches in depth; egg-cavity 2½ inches in width by 1 inch in depth.

719(M). 76. ZOSTEROPS ALBIGULARIS Gould.

White-breasted Silver-eye; Grinnell (N.I.).

Zosterops albigularis Gould, p.535; Ramsay, p.37; North, 'Nests and Eggs,' p.413.

Hab.—Norfolk Island.

This handsome Silver-eye is very plentiful in the vicinity of dwellings, and especially favours the fruit-gardens with its presence. It has a loud and not very musical note when in flocks, and a number of the birds arguing together make a noise similar to a mob of quarrelling house-sparrows. Solitary birds, however, occasionally indulge in a long-sustained liquid song, very pleasing to the ear.

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* Mr. Herbert Wilson has since sent me a nest of this species containing two eggs, taken on 20th November, 1909. The eggs are of the usual Zosterops colour; pointed ovals. Dimensions : *a*, 0·88 × 0·58; *b*, 0·82 × 0·58.

Its nest is an open cup-shaped structure, $3\frac{1}{2}$ inches in diameter, formed almost entirely of dried grasses, very sparingly mixed with a few hairs or pieces of wool. It is generally placed amongst the matted twigs of a lemon tree, or concealed in the thick masses of grey-green Spanish moss hanging in streams from the pine boughs, or matted amongst the twigs of the "currajong" trees. It is generally a difficult nest to find owing to the selection of natural foundations upon which it is so constructed as to be practically invisible from below.

Eggs, clutch three to six, uniform pale blue, rather more inclined to stout ovals, and smaller than those of *Z. tenuirostris*. Dimensions of a clutch of six: *a*,0·76 × 0·60; *b*,0·74 × 0·59; *c*,0·79 × 0·59; *d*,0·77 × 0·56; *e*,0·73 × 0·59; *f*,0·71 × 0·54 (12th Nov., 1908).

720(M). 77. ZOSTEROPS TENUIROSTRIS Gould.

Long-billed Silver-eye; Grinnell (N.I.).

Zosterops tenuirostris Gould, p.563; Ramsay, p.37; North, 'Nests and Eggs,' p.412.

Hab.—Norfolk Island.

This species does not appear to be locally distinguished from *Z. albigularis*, than which it is much less common. Its nest is similar to that of the preceding species.

Eggs, clutch three to six, colour uniform pale blue, the texture of the shell being very fine and slightly glossy.

Dimensions:

(1) *a*,0·84 × 0·59; *b*,0·88 × 0·6; *c*,0·85 × 0·59 (31st October, 1908).
(2) *a*,0·92 × 0·64; *b*,0·9 × 0·6 (12th November, 1908).

855(M). 78. APLONIS FUSCUS Gould.

Cūdgimarūk (L.H.I.); Black Bird (N.I.).

Aplonis fuscus, Ramsay, p.37; North, 'Lord Howe Island,' p.45; North, 'Nests and Eggs,' p. 373.

Hab.—Lord Howe and Norfolk Islands.

This bird, allied to the mainland genus *Calornis*, is common to both Islands. It is a bold and noisy marauder, creating havoc amongst the banana plantations and orchards. Its soft, slaty-grey plumage, darker in the male than in the female, is somewhat at variance with its bright orange-red eyes; and its assertive manner, attitudes, and loud challenging notes are not in keeping with its sober coat. I have often watched a pair attacking a bunch of bananas hanging to ripen under the verandah of the house where I was staying at Norfolk Island. The male would utter a few calls from an adjacent pine-tree, and then dart on to the iron roof, making a great clatter as he alighted. Then, whistling a sharp staccato note at short intervals, he would drop on the bananas, rip open the ripest, and swallow large pieces of fruit, uttering satisfied notes between mouthfuls. The female would follow, with less noise and assurance, and in a few minutes the empty banana skin only would remain. A sudden movement on my part would send the birds back to the pine-tree where they scolded for a while, and then returned to scoop out another banana.

The nest is a slight open structure of small twigs and dry grass, placed in the hollow spout of a dead limb, or (at Norfolk Island) in the trunk of a dead tree-fern, at varying heights from the ground. Some that I saw at Norfolk Island were within easy reach from the ground. The birds resort year after year to the same nesting-place, and, if robbed, will rebuild in the same spot. Breeding seasons, September to November, and February to March. The Lord Howe Island local name is onomatopoetic, based on the birds' usual cry. Eggs, bluish-green, sparsely freckled and blotched with pale red, chiefly towards the larger end. The eggs of a set generally vary considerably in size and shape. Clutch, four, occasionally five.

Dimensions:

(1) *a*, 1·02 × 0·75; *b*, 1·12 × 0·75; *c*, 1·03 × 0·77; *d*, 1·04 × 0·75. (Lord Howe, 15th Sept. 1907).

(2) *a*, 1·05 × 0·75; *b*, 1·02 × 0·75; *c*, 1·11 × 0·75; *d*, 1·12 × 0·72; *a* and *b* are oval; *c* and *d*, biconical (Norfolk Island, 31st Oct. 1908).

(3) *a*, 1·04 × 0·75; *b*, 1·04 × 0·75; *c*, 0·91 × 0·77; *d*, 0·90 × 0·64; (Norfolk Island, 20th Feb. 1909).

875(M). 79. STREPERA GRACULINA White.

Pied Crow-Shrike: Magpie (L.H.I.).

Strepera crissalis, Sharpe, Brit. Mus. Cat. iii, p.58, pl. ii.; Ramsay, p.37; Etheridge, ‘Lord Howe Island,’ p.10.

Hab.—Lord Howe Island. (Queensland, New South Wales, Victoria).

The Pied Crow-Shrike is found only on Lord Howe Island. It is very plentiful in the sheltered palm-glades in the vicinity of settlement, where its musical whistling call rings out with an almost human intonation. I was not fortunate enough to procure either nest or eggs, but was informed that it constructs a loose platform of twigs and small sticks on the thin outer branches of large trees, generally selecting one growing out from one of the "faces" or cliffs of Mount Lidgbird. Its breeding-haunts are in the hills, and the season is from July to September.

EXPLANATION OF PLATES L.-LIV.

Plate l.

Eggs of *Sterna fuliginosa* Gmelin, showing variations in markings and dimensions; nat. size.

Plate li.

Eggs (nat. size) of

1. *Gygis alba* Sparrm. [upper row].
2. *Micranous leucocapillus* Gould [lower row; first and second from the left].
3. *Procelsterna cinerea* Gould [lower row; third and fourth from the left].

Plate lii.

Eggs (nat. size) of

1. *Anous stolidus* Linn. [upper row].
2. *Phaëthon erubescens* Rothsch. [lower row].

Plate liii.

Fig. 1.—Egg of *Gygis alba* Sparrm., in position as laid in a knot-hole in the horizontal branch of *Lagunaria Patersoni*.

Fig. 2.—Nest and eggs of *Rhipidura cervina* Ramsay; one-half nat. size.

Plate liv.

Nest and eggs of *Pachycephala contempta* Hartert; one-half nat. size.

NOTE ON SOME RECENT WORK ON THE ROCKS OF SAMOA.

By H. I. Jensen, D.Sc.

I have recently received from Professor M. Weber, of Munich, an exhaustive report on the petrography of the Samoan Islands, worked out from a collection of rocks made by Herr J. Friedländer in 1907.* The report is, to me, of extreme interest, since it casts further light on two problems already discussed in my papers.

In my chemical note on a recently erupted hyalopilitic basalt from Savaii † my analysis showed a higher soda-content than might have been expected from the petrological description. I explained that this was probably due to the existence of an alkaline matrix in the glassy base, and to a high alkali-content in the greenish-brown augite. Professor Weber has examined a specimen of the same lava and has also found the felspar to be *bytownite*. He has not analysed this specimen, but in his other analyses of older Savaiian lavas he finds, as I did, that their titanium-contents are remarkably high; and he also finds that many of them approach, both mineralogically and chemically, to the alkaline division of igneous rocks. My own researches were confined to those specimens which I collected near the active volcano, and near Apia in Upolo; hence I failed to discover any rocks of a distinctly *alkaline facies*. The rocks described by Professor Weber include felspar-basalts, palagonite-tuff, phonolite, nepheline-basanite; and, from the island of Tutuila, which I did not visit, he describes alkali-trachyte, and phonolitic trachyte as well.

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* Weber, M., "Zur Petrographie der Samoa-Inseln," Abh. d. ii. Kl. K. Bay. Akad. d. Wiss. zu München. xxiv. 287, 1909.

† These Proceedings, 1907, p.706.

From the island of Aunuu he describes trachydolerites and palagonite-tuff. This is a very welcome addition to our knowledge of alkaline rocks, and fully confirms my surmise that there must have been an alkaline base in the basalt which I analysed.

The second point which I wish to touch on is, that the subalkaline composition now established by Weber for the Samoan lavas, casts some doubt on my hypothesis that the eruptions along the Samoa-Tonga-Taupo-line depend upon an earthfolding movement. In my paper on "The Distribution, Origin, and Relationships of Alkaline Rocks" * I emphasised the point that alkaline and subalkaline (mixed) magmas are erupted mainly in regions where great movements along fault-planes of the normal type are in progress, and not in regions of compression (an adaptation of Prior's view). Whether, therefore, the subalkaline magmas of Savaii are the result of further block-faulting in the Pacific, or of a minor fold-movement subsequent upon the break-up of the Fijian continent, or to the magmatic differentiation of normal calcic magmas connected with a more extensive fold-movement, is a problem that must be left in abeyance.

Dr. Weber also draws attention to the fact that mixed magmas are becoming recognised in far more localities than formerly supposed. In the Pacific area they have been reported from the Sandwich Islands, the Caroline Islands, Dunedin district in New Zealand, the Island of New Pomerania of the Solomons, and other islands, as well as from Samoa. Dr. Weber remarks that it becomes increasingly difficult to draw a sharp line of demarcation between alkaline and alkali-calcic rocks, and that our interpretation of a petrological province will vary according to geological time. Those are matters to which I, too, have drawn attention in my thesis on the subject. I offered an explanation of the origin of mixed magmas which, as yet, I see no reason to alter. With regard to geological time, it appears that those petrographical provinces which are almost wholly pure alkaline

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* These Proceedings, 1908, p.491.

most frequently are of Eocene age. Those which are very mixed sometimes antedate, and sometimes follow this geological period.

With regard to volcanic succession, I am of the opinion that in Samoa essentially the same order obtains as in the Eastern Australian alkaline province, namely, the most alkaline rocks antedate the more normal felspar-olivine basalts. The volcanic succession so commonly observed in Australian alkaline areas is, however, not universal. It does not hold for the Vesuvian area, nor for the Dunedin area. In mixed provinces, indeed, there is seldom any regularity of succession, and this fact goes far to justify the genetic distinction between alkaline and calcic magmas.

Dr. Weber's work renders it still clearer that to refer to alkaline rocks as the Atlantic type, and to calcic rocks as the Pacific type is an unfortunate system of nomenclature; and I feel strengthened in my view that the former constitute a rift-valley (katepeiric) type, whereas the latter constitute a type accompanying mountain-folding, geanticline-formation, and overthrust (anepeiric).

STUDIES IN THE LIFE-HISTORIES OF AUSTRALIAN ODONATA.

No. 3. Notes on a new species of *Phyllopetalia*; with description of nymph and imago.

By R. J. Tillyard, M.A., F.E.S.

(Plate lv.).

Under the name of *Petalia apollo* Selys, I described, in 1906,* as new to the Odonate fauna of Australia, a remarkable insect, of which two females had been taken by Mr. G. A. Waterhouse, at Leura, Blue Mountains, in November, 1903. The type-specimens of *P. apollo* came from Chili, which is doubtless the natural habitat of this species. The fact that a species, apparently the same, had been taken in Australia, elicited much surprise, and also considerable doubt, amongst my European correspondents. However, I established beyond doubt that Mr. Waterhouse's captures were authentic; for he assured me that it was quite impossible that he had made a mistake in the matter, that he had never received any dragonflies from Chili, and that he distinctly remembered capturing them at Leura, the occasion being impressed on him by the unusual beauty of the insects themselves.

It remained, then, that someone should rediscover the insect, either in its old locality, or from a new district. During the few visits I have had to the Blue Mountains, I kept a sharp look-out for it. But I never succeeded in finding it until last November, when I saw a dragonfly, which was certainly of this species, flying at the top of Evans's Look-out, Blackheath. I was unable to capture it, but was near enough to see that it was a male, and that the colouring of both the wings and body was exceedingly

* "New Australian Species of the family *Æschnidæ*." These Proceedings, 1906, Vol. xxxi., p.722.

beautiful. This was on November 7th. Two days later, during a heavy rainstorm, one of my pupils, Mr. Keith Brown, was out collecting crustacea at Leura Creek, with Mr. Alan McCulloch, Zoologist at the Australian Museum, when his attention was drawn to a dragonfly fluttering at the side of the cascades. It had evidently only lately emerged, and its wings were considerably knocked about. In a swirling pool of water near by, he found the larval skin; little knowing what a prize he had secured just in time, for soon afterwards the whole creek was a raging torrent, and the precious exuviæ would have been swept over the falls. Both imago and exuviæ were placed in alcohol, and brought to me in the hope that they might prove of interest.

I was delighted enough to have this material corroboration of Mr. Waterhouse's capture in the form of the imago; but that in itself pales into insignificance before the discovery of the larva, which is absolutely the first recorded larva ever found, of the remarkable *Petalia*-group of *Odonata*. I think all Odonatologists will be thankful to Mr. Brown for his great find, especially because it was out of a kindly interest in Nature and generous thought for the needs of someone else, that he, with no interest whatever in entomology, secured this great treasure.

During the rest of November and December, 1908, I visited the locality whenever possible, and kept a careful look-out for this rare insect. I also dredged carefully along the creek on each occasion. But I never found either larva or imago. Apart from giving a careful description of both, I am only able to say that there are two interesting points to be noted with regard to the species. The first is, that both Mr. Waterhouse's specimens were females, and so is that taken by Mr. Brown, and they were taken in exactly the same spot. The second is that they were all taken at the beginning of November, and that the insect has never been seen at any other period. It suggests to me a way of accounting for the extreme rarity of the insect. May not the imagines, directly after emergence (and in particular the males) disappear into the trackless forest, as is the case with some American *Gomphinæ*, and possibly never appear again on the creek except for oviposition, and then only for a very brief period, and possibly during the early morning or late evening.

As to the identity of the insect with *Phyllopetalia apollo* Selys, I have compared the wing-patterns of the two species, and find several small differences. Just as in the *Gomphinæ*, it must be remembered that the wing-venation varies very little, not only amongst closely allied species, but even amongst groups of genera Hence, even if the wing-patterns of both species had absolutely corresponded, both in neuration and in the position of the spots, it would not have followed that they were the same species. As regards the body-colouration, that of Mr. Waterhouse's specimen was quite obliterated when I examined it; so that it was impossible to assert definitely that it was a new species. However, the markings of Mr. Brown's specimen, carefully preserved for some weeks in alcohol, are very clear indeed, and enable us with safety to compare it with the species described by Selys.

The description of Mr. Waterhouse's specimen will be found under the heading *Petalia apollo* Selys, on p.723 of these Proceedings for 1906, (Vol. xxxi). To that description it is now necessary to add the points in which Mr. Brown's specimen differs, and to give the full scheme of beautiful colouration which was obliterated in the former specimen.

That the insect is absolutely distinct from *Phyllopetalia apollo* Selys, but probably of the same subgenus, I am convinced. I propose to name it *Phyllopetalia patricia* in honour of my wife.

PHYLLOPETALIA PATRICIA, n.sp. (Plate lv., fig. 3).

Total length 57 mm; abdomen 42 mm; forewing 41 mm; hindwing 39 mm.

W i n g s beautifully spotted with brilliant deep crimson spots, placed as follows :—On all four wings a long narrow basal mark, receding from the costa, but reaching beyond the arculus to the fourth antenodal; in the submedian space the next cross-vein in forewing, and next three in hindwing are clouded with crimson; a rounded spot of smaller size is placed about half-way between base and nodus, and *on the forewing only* there is an even smaller spot between this and the nodus. Enveloping the nodus is a large, somewhat squarish, irregular spot; half-way between the nodus and pterostigma a smaller squarish spot is affixed to the median vein but does not enter the costal space. *Exactly under* the pterostigma, but scarcely as long as it, is another large spot; finally, there is a large spot at the tip of the wing. Colouration of the head dark brown, with bright green transverse bands below the front and on the labium, these appearing yellowish-brown in the dead insect. Thorax reddish-brown, with six narrow straight stripes, all brilliant pea-green; the dorsal pair narrowest, the two lateral ones on each side broader and slightly paler. Abdomen rich reddish-brown, beautifully marked with bright pea-green as follows:—2, auricles green, a pair of oblong basal dorsal spots, a pair of larger oblong dorsal spots beyond the transverse carina, which is black, as are also the segmental sutures: 3-7, a pair of elongated basal dorsal marks, and on each side, low down, an elongated oval lateral spot; behind the transverse carina a pair of oblong dorsal spots; all the dorsal spots lying longitudinally in pairs, and on each side of the dorsal ridge: 8, basal dorsal marks reduced to small round spots; transverse carina absent, a pair of basal lateral spots as in 6, a pair of divergent oval anal dorsal spots: 9, a pair of elongated dorsal marks; 10, a pair of small dorsal spots: 8-9, slightly dilated below in lateral folds, those of 9 edged with green. Ovipositor large, thick, dark red, of distinct *Aeschnine* form, furnished with two divergent filaments, each formed by a rather thick basal joint 1 mm. long, tipped with a fine curved hair; between these, which are very wide apart, are two very finely curved hairs, also wide apart and divergent. Appendages short, 1 mm., wide apart; rather thick, black, slightly convergent, tips bent downwards and ending in a blunt point.

Hab.—Leura, Blue Mountains, N.S.W. (November).

This species is considerably smaller than any of the three Chilian species, though it comes nearest in size, and also in the pattern of its wing-spots, to *Phyllopetalia apollo* Selys. I have before me a photograph of the wings of this latter species, kindly sent me by my friend, Dr. Ris. In the wing-spots the differences are as follows:—basal spot cf *P. patricia* narrower than in *P. apollo*, but longer, reaching to beyond arculus and fourth antenodal, (that of *P. apollo* does not reach the second antenodal), but not keeping close to costa as in *P. apollo*. Second spot (intermediate between base and nodus) smaller than in *P. apollo*, scarcely touching the costa in hindwing and not at all in forewing. *Another roundish and somewhat smaller spot interposed, in forewing only, on the fourth antenodal from the nodus* is found only in *P. patricia*, and not in *P. apollo*. Third (nodal) spot shorter and squarer than in *P. apollo*, covering only one postnodal instead of two. On all four wings in *P. patricia* there is *a fourth spot placed below the median nervure midway between the nodus and pterostigma*, covering two quadrilateral cells under the median and two smaller pentagonal cells beneath. No such spot exists in *P. apollo*. Fifth spot (under pterostigma) is placed in *P. patricia exactly* under the pterostigma but is not quite so wide as it; in *P. apollo* it is somewhat more rhomboidal in shape, and is placed half *before* and half *under* the pterostigma. Sixth (apical) spot slightly smaller than in *P. apollo* All the spots in *P. patricia* brilliant crimson with darker borders; transparent, and appearing in a bright light as brilliant as a ruby. Spots of *P. apollo* (apparently) rich brown.

As in *P. apollo*, so in *P. patricia* there are two rows of cells in the postcostal area of the forewing. The pterostigma of *P. patricia* is somewhat shorter than that of *P. apollo*. As regards colouration, it is difficult to say what may be the true colours, in life, of the Chilian species; but I have never seen any dragonfly amongst the *Æschnidæ* which, in point of absolute beauty of colour and pattern, could vie with *P. patricia*. The deep rich reddish-brown of the abdomen, studded as it were with brilliant gems in the shape of the numerous green spots and markings, marks it out as standing alone amongst the *Æschnidæ* for absolute beauty; while the wonderful display of transparent red light in the wing-spots is quite unparalleled in that family. We may expect the male, when discovered, to be no exception to the general rule, but to outvie even the beauty of the female.

We must now turn our attention to the cast-skin of the nymph, which is a most remarkable object, and in many respects quite unlike any other known dragonfly nymph (see Plate lv., fig.1.):—

Total length 35 mm., abdomen 23 mm., head 5·5 mm. long by 9 mm. wide; width of prothorax 5·2 mm., of mesothorax 7·3 mm., of metathorax 8 mm. Greatest width of abdomen 10·8 mm. at segment 5. Wing-cases 7 mm. long.

Colour, a nearly uniform dull brown all over; nearly the whole of the upper surface of the head, thorax, legs, and abdomen finely granulate. H e a d large, of distinct *Æschnine* form; *eyes* very large and prominent, *postocular areas* very granulate, rounded behind, but with the margins irregularly wrinkled, and with a small tubercle projecting just behind each eye. *Vertex* large, broadly shield-shaped, the three *ocelli* set right at the back close to the prothoracic border; *antennæ* wide apart, 2·5 mm. long, seven-jointed, the three basal joints thickened, the four terminal ones thin, longer. (Probably the position of the ocelli and antennæ is too far back in the exuviæ, owing to the backward shifting of the vertex over the postocular area after transformation); *front*, *clypeus*, and *labrum* very granulate, the latter widest, bordered with a dark line on the lip, carrying a row of tiny close-set pale hairs. L a b i u m very strong and muscular; basal joint very strong and thick, well rounded beneath, and nearly 2 mm. through. *Mentum* fairly flat, but very muscular; almost square, but slightly narrower basally and with the sides slightly curved; very strong and thick, being quite 1 mm. through on each side, lateral edges slightly upcurved and furnished with a row of very small spines; *median lobe* only very slightly prominent, edged with fine hairs. *Lateral lobes* carrying a very large sharply pointed outer tooth, from behind the basal portion of which there arises a large inner tooth, shorter and blunter than the outer one, and possessing a finely serrated inner edge (see Plate lv., fig.2). T h o r a x : *prothorax* well formed, with a prominent frontal collar and large upper and lower lateral spiny projections on each side; upper and lateral surface entirely granulate except for a small sunken double spot on each side of dorsum. *Meso-* and *metathorax* large, wrinkled, raised high above level of abdomen. *Wing-cases* laid parallel, their upper sutures meeting at right-angles and slanting away downwards on each side at an angle of 45° to the dorsal line; smooth, very dark brown, with tiny black granular spots along the principal nervures, and a very dark patch on nodus of forewings only. *Legs* exceedingly wrinkled and furnished with several irregularly placed blunt spines on femora and tibiæ; surface of femora distinctly granulate, of tibiæ finely so; *tarsi* three-jointed, the two basal joints very short, the terminal one longer than the other two together and ending in two sharp reddish claws. Lengths of femur, tibia and tarsus respectively as follows :—fore-leg, 5, 5, 2·5 mm.; middle-leg, 6, 5, 3 mm.; hind-leg, 7, 6, 3·5 mm. Abdomen elongate-oval, flattened, widening gradually from 1 to 5, then narrowing slightly to 9; 10, very much narrower. Surface of all segments finely granulate except along sutures and on a series of small oval depressions, not easily noticed, arranged down each side of the dorsal surface. Each segment from 2 to 8 ends on each side in a remarkable protuberance of a peculiar curved form somewhat like a fin; these increase in size up to segment 8; in segments 2-5, these protuberances are distinctly upcurved, in 6 less so, in 7 nearly flat, while in 8 they are quite flat and broad. On 4-8 there are two small anal dorsal tubercles close together, and on 4-7 a second pair placed one on each side, farther from the dorsal line: 9 has flattened edges coming gracefully inwards anally, and then projecting out so as to enclose the basal part of 10: in 9 the two anal dorsal tubercles have practically coalesced to form one larger one: 10 small and possessing no tubercle. *Terminal appendages* five, of which the two outer (lateral) ones are longest, 2·2 mm., narrow conical, converging, pointed; the median one broader and shorter, 1·7 mm., subtriangular, tip truncate; the other two short, narrow subconical, 0·5 mm., lying on each side of median and above the inner portion of the lateral ones.

The discovery of this remarkable nymph should settle once and for all the true position of the *Petalia*-group of genera in our systematic classification. Hitherto placed with the *Cordulegasterinæ*, they must now be removed from that subfamily, and either added to the true *Æschninæ*, or placed next to the latter in a small subfamily of their own. The argument in favour of this change may be stated as follows:—

(1) In studying the position of the *Petalia*-group of genera, from a knowledge of the imagines only, too much stress has been laid upon *one* characteristic, viz., the fact that their eyes only just touch, as is also the case with *Cordulegaster*. Mainly on this character, they have been included in the *Cordulegasterinæ*, this subfamily having been distinguished from the true *Æschninæ* by the fact that, in the latter, the eyes are closely contiguous for a considerable distance. As a matter of fact, this character is really of less importance than others which have been entirely ignored by systematists in placing this genus. In the *Libellulinæ* we can recall the case of two closely allied insects, viz., *Crocothemis erythræa* Brullé, and *Rhodothemis rufa* Rambur, in which the chief difference is that the eyes of the former are, like those of nearly all *Libellulinæ*, closely contiguous; while in the latter, the eyes barely touch, and, in some specimens which I possess, are *absolutely separated*. Yet in all other respects these insects are closely allied, and their divergence in this one characteristic is only sufficient to place them in two different but closely united genera. We ought, therefore, in the case of *Petalia* and allies, to examine whether, in other respects, they show a remarkably close similarity to *Cordulegaster* or not. That they do not, is clear from the fact that the ovipositor of the females of *Petalia* is quite unlike that of *Cordulegaster*, and is of the true *Æschnine* form, and still suitable for the placing of ova in submerged tissues, a power lost to *Cordulegaster*, whose ovipositor is so modified that the insect is unable to penetrate tissues, but can only deposit its eggs in mud and shallow water by laboriously supporting itself vertically with its wings, and dragging its abdomen in the mud. Again, as regards wing venation, the shortness of the wing-triangle, with its one cross-vein, is nearly paralleled by *Gomphæschna* and *Brachytron*, admittedly *Æschnine*

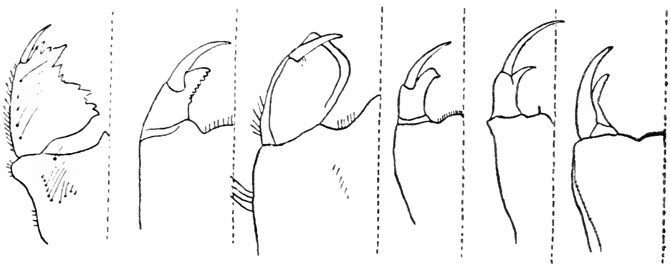
genera. While, on the other hand, the development of the anal area of the hindwing in *Petalia*, with its anal loop, is distinctly of an *Æschnine* form, that of *Cordulegaster* is more *Petalurine* in form. Hence, from a study of the imago only, we should be in doubt as to whether *Petalia* and allies were, or were not, after all, true *Æschnine* forms.

(2) As regards larval characters, I shall endeavour to show that, although the nymph of *Phyllopetalia* above described does possess one similarity to that of *Cordulegaster*, it is on the whole distinctly *Æschnine*.

As far as I can see, it is similar to *Cordulegaster* in one respect only, *viz.*, that it is apparently a liver amongst débris and trash on the bottom of the swift mountain-creeks. It possesses a curiously wrinkled body-surface, rough legs, and flattish abdomen, which go to prove this to be its habit of life. Against this we must set the following considerations:—

(*a*) The shape of its head, with its large rounded eyes and narrower curved postocular lobes, is distinctly *Æschnine*.

(*b*) A study of the labium is of the greatest importance in systematic classification, and the evidence it affords should go far to outweigh any argument based on less certain characters.



1. Cordulegaster diastatops Selys 2. Austrogomphus heteroclitus Selys 3. Petalura gigantea Leach 4. Aeschna brevistyla Ramb. 5. Staurophlebia reticulata Burm. 6. Phyllopetalia patricia n.sp.

In the text-figures I give outline sketches of the labia of six genera which bear on the point at issue. Fig.1 represents that of *Cordulegaster diastatops* Selys; fig.2 of *Austrogomphus heteroclitus* Selys; fig.3 of *Petalura gigantea* Leach; fig.4 of *Æschna*

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brevistyla Ramb.; fig.5 of *Staurophlebia reticulata* Burm.; and fig.6 is the labium of our new species, *Phyllopetalia patricia.* Of these, 1 belongs to the *Cordulegasterinæ*, 2 to the *Gomphinæ*, 3 to the *Petalurinæ*, and 4 and 5 to the true *Æschninæ.*

The most evident thing about them is that No.1 is of quite a different type from the other five. In it we have the development of mental and lateral setæ which characterises the *Libellulinæ* and *Corduliinæ* alone amongst the *Anisoptera*; while the triangular mentum, which when closed is hollow and almost cup-shaped, is also characteristic of these groups. Turning more especially to the lateral lobes, we notice the small movable tooth or hook, and the irregularly serrated inner margin of the lobe, which is itself broad and well-developed. Such characters are very close to those displayed by the nymphs of *Corduliinæ*, though, in that subfamily, irregular serration of the inner margin is replaced by more or less regular crenation.

In all the other five, we have a quite different type of labial development. Firstly, the mentum is broad and flat, not much narrowed at the base, and in repose is laid flat against the underside of the head. Neither mental nor lateral setæ are developed. The main attacking strength of the weapon lies in the great development of the "movable hook," which is now a huge tooth. The lateral lobe itself is not broad (except in *Petalura*), nor does it show on its inner margin any sign of dentation (except in *Austrogomphus*, which, as in many other *Gomphinæ*, has a finely serrate margin, while under a lens that of *Phyllopetalia* may be seen to be exceedingly finely serrate). With all their variations in the shape of the inner lobe, and the length of the large outer tooth, these five labia clearly represent phases of one line of labial development, which is recognised as being peculiar to the family *Æschnidæ* (excluding *Cordulegaster* for the present). The labium of *Phyllopetalia* itself is peculiar in having the large outer tooth reaching the whole length of the lateral lobe, and apparently jointed, if at all, on to the mentum; while the second and smaller tooth of the lateral lobe appears from behind it. Here is a development unparalleled by any other known genus of *Odonata.*

However, there is in some ways a very close resemblance between Nos.2 and 6, though the value of the comparison is lost for us, as systematists, by the evident differences, in other respects, between both nymphs and imagines of the *Gomphinæ* and *Phyllopetalia*. In the *Æschninæ* (figs.4 and 5) the usual form of the inner margin of the lateral lobe is the more or less squarely truncated end as shown in fig.4. But that other forms are still extant, may be seen in fig.5 (*Staurophlebia reticulata* Burm.), where both the large outer tooth and the smaller tooth of the inner margin are sharply pointed.

A further argument in favour of the similarity between the labial development of *Phyllopetalia* and that of the *Æschninæ* will be forthcoming on the publication by me, later on, of the life-history of *Telephlebia godeffroyi* Selys. The material for this paper is not yet worked up, but I am able to state that the labium of this remarkable primitive *Æschnine* form shows an even closer resemblance to that of *Phyllopetalia* than do any of the labia figured in the text.

To sum up, it seems to me that *Phyllopetalia* and *Cordulegaster* are by no means closely allied. In their nymphal stages the members of the latter genus exhibit remarkable structural differences from all the rest of the *Æschnidæ*, and should probably be separated out as a subfamily by themselves, and connected more closely to the *Corduliinæ* by way of *Macromia* and *Synthemis* *Phyllopetalia*, on the other hand, is probably less closely allied to *Cordulegaster* even than *Petalura* is, and must at any rate be removed from the *Cordulegasterinæ*. In my opinion, its correct position should be in the *Æschninæ* proper, next to *Telephlebia*, thus including in this subfamily all those genera in which the ovipositor of the imago is a true terebra or "borer."

As regards the nymphs, the following key will now serve to separate them :—

1.	Antennæ 4-jointed	*Gomphinæ*.
	Antennæ 7-jointed.	2.
2.	Labium with mental and lateral setæ, small terminal movable hook, and large irregular serrations on inner margins of lateral lobes.......... ...	*Cordulegasterinæ*.
	Labium with no setæ, large terminal tooth, little or no crenation of inner margin	3.

3. { Lateral lobe of labium very large, rounded........... *Petalurinæ*.
Lateral lobe of labium small and narrow, with tip variously shaped.................. *Æschninæ* (including *Phyllopetalia*).

In conclusion, I should like to express my thanks to my friend, Dr. Ris, for first pointing out to me the similarity between the ovipositors of *Phyllopetalia* and the true *Æschninæ*. The consequent conviction that *Phyllopetalia* was a true *Æschnine* genus is, I trust, happily vindicated by the present paper, on the evidence of this truly remarkable nymphal form.

EXPLANATION OF PLATE LV.

Phyllopetalia patricia, n.sp.

Fig. 1.—Exuviæ (× 2).
Fig. 2.—Labium (much enlarged).
Fig. 3.—Female imago (nat. size).

WEDNESDAY, NOVEMBER 24TH, 1909.

A Special General Meeting, together with the concluding Ordinary Monthly Meeting of the Session, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, November 24th, 1909.

SPECIAL GENERAL MEETING.

Mr. C. Hedley, F.L.S., President, in the Chair.

Business : (1) The confirmation of certain consequential alterations in Rules xvi., xxi., and xxiii., passed at the Special General Meeting of September 29th, 1909, having reference to the election of Auditor; and (2) [as arranged at the Annual General Meeting of March 31st, 1909] to elect an Auditor.

On the motion of Mr. J. H. Campbell, seconded by Professor David, it was resolved, that the amendments of Rules xvi., xxi., and xxiii.(as detailed in the Abstract for September) be confirmed.

Mr. T. Steel proposed, and Mr. R. H. Cambage seconded the motion, that Mr. F. H. Rayment, F.C.P.A., be re-elected to the position of Auditor. As no other nomination was forthcoming, the President declared the election of Mr. Rayment to be duly made.

ORDINARY MONTHLY MEETING.

Candidates for three Linnean Macleay Fellowships, tenable for one year from April 1st, 1910, were reminded that Tuesday, November 30th, was the last day for sending in their applications.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 29 Vols., 72 Parts or Nos., 21 Bulletins, 5 Reports, and 19 Pamphlets, received from 59 Societies, and 2 Individuals, were laid upon the table.

NOTES AND EXHIBITS.

Mr. Froggatt exhibited a collection of *Thynnidæ* (Flower-Wasps) comprising 135 named specimens, among them being 14 types and many co-types of the species described by Mr. Rowland Turner in his monograph of the family, published in the Society's Proceedings for 1907. These specimens at that time were in Mr. Turner's charge at the British Museum, and were not available for exhibition when the papers were read.

Mr. T. H. Johnston exhibited an extensive series of Entozoa from the Barracouta fish(*Thyrsites atun* Euphr.)—(1) *Tetrarhynchus* sp.(Sydney; Clarence River; Tasmania; Western Australia), an elongated form 5-15 cms. long, with swollen anterior end containing the scolex, somewhat like that of *Tetrarhynchus reptans* Wag.; infesting the muscles. (2) *Tetrarhynchus* sp.(Sydney), a short thick parasite about 2 cms. long, also from the muscles; the spherical rostella, and the general body-shape, seem to resemble those of *T. rugosus*. (3) *Tetrarhynchus* sp.(Sydney; Clarence River), a very small, actively motile cestode, with long rostella and powerful bothria, this immature parasite occurring commonly in and on the intestinal coats. (4) *Tetrarhynchus* sp.(Clarence River; Sydney), a tiny pedunculated cystic form, found on the mesentery and peritoneum. (5) *Sparganum* sp (Clarence River), a larval Bothriocephalid, about 1-5 cms. long, found in the outer coat of the intestine. (6) *Ichthyotænia* sp.(Clarence River), a young form with a well developed apical sucker; this occurs in the intestine. (7) *Echinorhynchus* sp.(Clarence River), from the intestinal walls. (8) Immature nematodes, regarded by Dr. G. Sweet, of Melbourne, as *Ascaris marina* Linn.; these round worms are extremely common in the Barracouta, occurring spirally coiled in great masses along the whole of the mesentery(Sydney; Clarence River; Tasmania; West Australia). With the exception of *Ascaris marina*(?) recorded from Victoria, none of these parasites have been noted before from Australia. The specimens were mainly collected by Dr. Cleland, and Messrs. F. H. Taylor, and T. H. Johnston.

Mr. Cheel showed a collection of Lichens, comprising—COLLEMACEÆ: *Dendriscocaulon filicinellum* Nyl.; associated with *Sticta* (*Stictina*) *cyphellulata* (Müll. Arg.), on rocks, at Belmore Falls, N.S.W.; and with *S.* (*Stictina*) *fuliginosa* S. Gray, on trunks of trees, at Upper Fern-tree Gully, Victoria; and with *Sticta filix* (Hoffm.) Nyl., at Ohakune, New Zealand. This interesting species was first recorded from New Zealand by Nylander, and afterwards by Dr. Jean Müller; Müller's specimens were collected by Colenso, Nos.1646, 1702, Herb. Kew., and recorded under the name of *Leptogium dendroides* J. Müll. (Bull. de l'Herb. Boissier, ii., Append. i., p.18, 1894); Journ. Linn. Soc.(Bot.) xxxii., 197 (1895). The late Rev. F. R. M. Wilson found it associated with *Sticta stipitata* C.Kn., at Mount Macedon, Victoria; and regarded it as the juvenile state of that species (*vide* Proc. Roy. Soc. Queensl., vii., p.8, 1889). Although a keen search was made both at Belmore Falls and Fern-tree Gully for *Sticta stipitata* C. Kn., no specimens were found, so it is concluded that it must be distinct.—PANNARIACEÆ: *Erioderma Knightii* Shirley(syn. *Platysma eriophyllum* C. Kn.); on branches of *Leptospermum scoparium* Forst., near Mount Ngongotaha, New Zealand(E. Cheel; March, 1909). Previously only recorded from Mount Mistake, Queensland, from specimens collected by Mr. F. M. Bailey in (Wilson Herb. No.1294) National Herbarium New South Wales.—Lichens are usually found attached to rocks, trees, or on the ground; but the following are of interest because of the different substances on which they are found, viz.:—*Parmelia limbata* Laur., var., on white glass; Gladesville (Miss M. Flockton). *P. conspersa* Ehrh., var., on leather, Lismore, N.S.W. (Rev. F. R. M. Wilson); on old sackcloth, Centennial Park (E. Cheel). *Caloplaca pyracea* Th.Fr., on bones; Lismore, Victoria (Rev. F. R. M. Wilson).

Dr. E. Cuthbert Hall exhibited a selected collection of flowering Carnations, representing some of the results of experiments in hybridisation which he had been carrying out for several years.

On the invitation of the President, Mr. F. Fox, a professional snake-collector, who has succeeded in rendering himself immune to snake-poison, gave an exhibition of his fearlessness and dexterity in handling venomous snakes (*Hoplocephalus curtus*).

THE VARIABLE CHARACTER OF THE VEGETATION ON BASALT SOILS.

By H. I. Jensen, D.Sc.

In my papers to the Society on the Glass House Mountains, and the East Moreton District of Queensland, I emphasised the point that, in these parts, the basalts were invariably covered with dense scrubs, whereas the sandstones and trachytes supported only a forest-flora. In my paper on the Geology of Mt. Flinders and the Fassifern District, I pointed out that, around Engelsburg, the trachytes were covered with scrubs, whereas the basalts in all the vicinity could boast only a sparing amount of forest.

Still more recently, Mr. R. H. Cambage, F.L.S., in the Proceedings, has called attention to the want of forest-vegetation on the basic rocks of the Monaro Plains, while the more acidic granites and porphyries, in that same district, support a fair amount of forest.

An observer acquainted only with the barren basaltic outcrops which occur isolated on the Western Plains, and in the Murrumbidgee basin, might well look upon basalt as a curse from an agricultural point of view; while it is hard to dissuade the man who has traversed the Darling Downs of Queensland from looking upon basalt as the source of our richest agricultural lands.

It is the object of the present note to explain why so many types of vegetation occur on basalt in different parts.

The character of the vegetation on any geological formation depends essentially on three factors—(1) the mechanical and chemical composition of the soil; (2) the character of the subsoil, and (3) the climate and climatology.

Before proceeding to discuss general principles, I desire to review the various types of vegetation which I have observed on basalt-formations. They will be dealt with in the order of their extent and importance.

A. *Basalt Scrubs* (Jungle-forests or Brushes).—Wherever sheets of basic lava cover large areas in the coastal districts of Queensland, or of New South Wales north of the Nambucca River, magnificent "scrubs" are found to be coextensive with the basalt-formation. Only here and there may a patch of forest-country be seen, and on closer examination it will always be found that such a patch is accounted for by either—

(*a*) Rapid drainage of the soil, as on the summit of a peak or of a razorback range; or

(*b*) The existence on the spot of a formation of porous tuff; or

(*c*) The presence of a felspar-basalt, porphyritic in acid plagioclase, which, by resisting weathering longer than the other constituents, gives a more sandy and porous texture to the soil.

So that where a forest-patch is found on basic volcanic rock in a tropical or subtropical coastal area, the occurrence is always due to superior porosity and drainage of the soil. The forest-trees which predominate on such patches are always those which are typical of good soils on other formations, namely, box, ironbark, apple, and blue-gum.

In isolated places where a depression without an outlet occurs in basalt country, either on a peak or on a plateau, an absolutely treeless stretch of country may occur. The only vegetation consists of reeds and brush. Such barren areas are the result of complete absence of drainage, leading to the soil becoming sour, and the soil-water becoming saturated with soluble salts deleterious to plant-life.

B. *Basalt Plains.*—West of the Great Dividing Range, large basalt-areas are almost treeless. The Darling Downs possess only a few straggling trees on the small knobs or hillocks, which are dotted over it at intervals. The hillocks invariably possess a more stony and porous soil than the level country, hence the trees can take root. In New South Wales, similar facts may be observed both in New England and on the Liverpool Plains.

C. *Basalt Knolls.*—In the western interior of New South Wales, smaller isolated basalt-areas are abundant, and are often so extremely stony and bare of soil as to be useless for anything but sheep-grazing.

D. *Basalt Ranges.*—In the southern coastal districts of New South Wales basaltic ranges, like the Cambewarras, occasionally occur. These are partly clad with forest, and partly with a scrub somewhat less dense and luxuriant than the northern ones.

E. *Basaltic Bogs.*—On the Southern Tablelands, and in the Australian Alps in particular, there are many elevated basaltic plains with a poorly developed drainage. In such places the soil is cold, sour, and charged with mineral salts to such an extent that forests cannot establish themselves. Sedges, grasses, and reeds alone are able to exist.

Having now described the different types of basalt-country, it becomes necessary to define what factors control the vegetation of each.

A. *Basalt Scrubs.**—These are all found in tropical or semi-tropical, damp, or rainy climates. Rock-weathering is rapid and penetrates deeply, because water charged with organic acids sinks into the rock, and chemically attacks it. The soil is consequently deep as well as fertile. The dense scrub prevents the products of rock-decomposition from being rearranged in layers, or mechanically transported to any extent, except on steep slopes. The subsoil, therefore, is generally similar to the surface-

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* "These are, properly speaking, forests, tropical forests with the character of the Indian jungles. . . . . I think it would be better if the term "scrub" were not applied to these forests. They are so utterly different from what is included under that name in other parts of the Colony, that jungle would be a far better expression. . . . . In the true Australian scrub usually one or two species predominate, in fact almost exclude every other. The jungle forests are of a much more mixed character. No one genus or even species gives its character to the forest. . . . . In New South Wales, such forests are called 'Brushes.'" [Tenison-Woods, Botanical Notes on Queensland, No. v., The Forests or Scrubs. These Proceedings, vii., pp.538-569, 1882(1883)].

soil, though somewhat richer in mineral plant-food. The Blackall Range Scrubs, in South Queensland, are of this type. The soil is chemically very rich, and consists of dark brown or black clayey loams. It has high water-retaining power, but low porosity; and always suffers from sourness, and lack of aëration. This is, however, no disadvantage to the typical scrub-plants, which will flourish only in sour, heavy, and wet soils. On steep slopes, the soils of basaltic scrubs may, through leaching, be poorer than usual in this type of country.

B. *Basalt Plains.*—The soil of these areas has the same characteristics as that of the scrubs, namely, depth, richness in plant-food, high water-capacity, low capillary power, and lack of aëration. The cause which produces the dearth of vegetation is, that those Australian trees which can live in heavy, impervious, unaërated soils, namely the scrub-flora, are prevented from establishing themselves by the lack of rainfall, and sometimes by the cold climate of the tableland as well. It is more difficult to see why the forest-vegetation of more acid formations has been unable to adapt itself to the much richer soil of the basalts. If the typical forest-flora of Australia is very old, as we have reason to believe, it is reasonable to suppose that it possesses an hereditary aversion to soils of a heavy, clayey nature.

Prior to the Miocene, there was little basic rock in Eastern Australia, and the greatest basalt-areas are still later, namely, Pliocene. Before the great basaltic extravasations, almost all the soils of this continent were of a loose, porous, sandy nature. Such soils, though poor in plant-food, are not only well aërated, but are also able to supply any deficiency in rainfall by absorbing moisture from the dew or from the atmosphere by capillarity. If heavy rains fall, the surplus water readily drains away. But the basaltic soils, of the Miocene and Pliocene outpourings, are heavy, clayey, impervious to air and water. They have so high a water-capacity, and so poor a porosity, that in heavy rains they become water-logged, and the tree-roots are suffocated; while in a prolonged drought they dry up to such an extent that the trees die of thirst, the capillary power of the soil being so slight that dew and atmospheric vapour cannot find their way down. For these reasons, the forest-flora, specially adapted for the silicious porous soils, has never been able to transplant itself to the basalt-areas.

It is also possible that the cracking of these heavy soils, in dry weather, may fracture and tear tree-roots to such an extent, that forests are unable to establish themselves.

C.—The *Basalt Knolls* of the western interior owe their bareness to two causes. In the first place, basalt is such a compact, homogeneous, and even-grained rock that, in an arid climate where organic acids (from decomposing vegetation) and moisture are at a minimum, decomposition is extremely slow. Granite, porphyry, and sandstone are much more readily disintegrated by heat and frost. In the second place, the minerals of basalt are all decomposed with about equal readiness, there being no specially hard and resisting mineral, like the quartz of granite. Therefore, the soil formed by the disintegrating basalt is very finely divided, and is readily blown away by the wind. The wind practically removes the soil as fast as it is formed, on the basalt knolls of the arid interior.

D.—The basalt-ranges of the south of New South Wales along the coast, differ from the Queensland ones in having a colder climate, and lower rainfall, two factors which prevent a semi-tropical, true scrub from establishing itself. Rapid corrosion and erosion, unhindered by dense vegetation, have given rise to steep slopes, which again have been the cause of such an excellent natural drainage, and such a stony soil, that forest-vegetation has had no difficulty in asserting its supremacy.

The basaltic ridges of the Little Liverpool Range and Fassifern District of Southern Queensland owe their forest-flora to a similar cause. The climate of this region is much drier than that of the coast, but wetter than the Darling Downs, whose eastern flank is formed partly by these ridges. Springs never occur here in the basalt-lavas, and the slopes are steep. Consequently we have here conditions intermediate between those of the scrub-decked coastal basalts, and the bare plains of the Downs. The soils, being rapidly removed by streams and rain-torrents on the steep slopes, are fairly shallow and stony, well drained and porous, hence a healthy forest-vegetation has been able to establish itself.

E.—The *Basaltic Bogs* of plains and tablelands owe their want of a forest-flora to inefficient drainage. The soil is water-logged and the soil-water is charged with salts which are detrimental. The roots of trees would get suffocated and would rot.

It will be seen from the above account that the defect of basaltic soils is never want of plant-food. The worst faults are high water-capacity, which causes the drowning of plants in wet weather; and the low capillary power, which impedes a renewal of soil-moisture in droughty seasons. Silicious soils lose their moisture quickly enough, but they are able to get supplies from the subsoil, because of their high capillary power and porosity.

Chemical Composition of Basalt-Soils.

The following table gives some idea of the comparative value of different soils, based on their manurial ingredients (Table i.). The richness of the basalt soils is indisputable, and it is only their mechanical condition which is adverse to always getting good results. They must be kept in a continual state of aëration by frequent ploughing, and any cereal crops which do not root too deep will flourish on them. The addition of substances which will increase the capillary power, such as sand and sawdust, can always be employed to improve the texture of heavy basalt soils.

The Richmond River volcanic soils, whose average composition has been calculated by Mr. Guthrie,* will be seen to be rather poor in potash as compared with the other basaltic soils. This is due to the dense vegetation in the Northern Rivers district. The sandy soil from the Pilliga scrub, which is covered with a dense pine jungle, is likewise deficient in potash as compared with Hawkesbury Sandstone soil.

Although basalt-soils are generally of good quality, they may in certain situations be reduced by leaching to the condition of

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* Agricultural Gazette of New South Wales, 1900.

TABLE I,

SHOWING AVERAGE COMPOSITION OF SOILS TYPICAL OF VARIOUS GEOLOGICAL FORMATIONS.

Geological Formation.	Number of Analyses Averaged.	Dominant Colour.	Usual Reaction.	Mean Water-Capacity. %	Capillary Power.	Mean Clay %	Lime, CaO. %	Potash, K_2O. %	Phosphoric Acid, P_2O_5. %	Nitrogen, N. %	Volatile. %
Slate	3	light	acid	28·2	good	41·6	0·066	0·055	0·069	0·066	4·26
Hawkesbury Sandstone	over 100	light	acid	low	good	low	0·106	0·066	0·137	0·133	7·22
Pilliga Scrub Sandstone	1	light	acid	2·9	good	13·0	0·152	0·019	0·045	0·056	9·75
Granite	128	light	acid	37·7	good	38·0	0·190	0·140	0·109	0·103	5·34
Basalt	5	dark	neutral	48·8	low to fair	63·4	0·565	0·084	0·107	0·170	8·00
Limestone	10	dark	alkaline	44·9	fair to good	56·4	0·765	0·350	0·181	0·104	6·76
Alluvials	5	dark	neutral	46·0	fair to good	84·8	0·686	0·242	0·291	0·165	8·28
Black Soil Plains	6	dark	neutral	62·7	very poor to good	78·0	0·635	0·330	0·174	0·092	7·00
Volcanic, Richmond River	—	light	acid	52·0	good	25% to 75%	0·210	0·080	0·300	0·300	16·00

clays composed of iron-oxide and alumina (laterite and bauxite clays), and rather deficient in mineral plant-food. This would be particularly the case on a naturally well drained basaltic plateau, when the basalt is rich in alkali, and the rainfall is good. Then the dense scrub-vegetation extracts the potash as fast as it is liberated; carbonic acid and ammonia generated by the decomposing vegetation and other organic matter, sink into the subsoil, and leach out of it the lime and silica respectively. The soda likewise filters away in solution.

As an instance of this, one might quote an analysis of basaltic subsoil from Cape Diego, in North Madagascar, which gave the following result :—

Insoluble residue	81 per cent.
Sesquioxide of iron	19 ,,

There was no lime, no alumina, very little potassium and phosphoric acid. The surface soil was richer, containing—

Nitrogen	0·17 to 0·79 per cent.
Phosphoric acid	0·15 to 0·44 ,,
Potassium...	0·01 to 0·07 ,,
Lime	0·00 to 0·03 ,,

Where the soil is alluvial, though of basaltic origin, redistribution of ingredients, and leaching will, of course, frequently give rise to layers of poor, clayey soil.

CONTRIBUTION TO OUR KNOWLEDGE OF AUSTRALIAN *HIRUDINEA*. PART iv.

WITH A NOTE ON A PARASITIC ENTOPROCTOUS POLYZOON.

BY E. J. GODDARD, B.A., B.Sc., LINNEAN MACLEAY FELLOW OF THE SOCIETY IN ZOOLOGY.

(Plates lvi.-lviii.)

PONTOBDELLA MACROTHELA Schmarda(1861). (Plate lvi.)

For a specimen of this species, I am indebted to Mr. Ogilby, Naturalist to the Amateur Fishermen's Association, Brisbane, who obtained it in the Brisbane River. This constitutes the first record of the species, I think, in Australian waters. The specimen resembles exactly that described by Schmarda from Kingston, Jamaica. I have taken the opportunity of re-examining the species externally, as I am not aware that it has been done since Schmarda's observations on it were made, especially as it is of some interest in regard to metamerism.

The measurements in the specimen preserved in alcohol were—length, 80 mm.; breadth, 10 mm.; depth, 5 mm.

Body.—Colouration a light yellow-brown; no traces of any other pigment in the form of stripes or dots.

The surface is exceedingly rough, owing to its being cut up into a number of tubercular areas, those on the middle annulus of each somite being enormously developed, and probably of greater importance, as regards size, than in any other member of the *Hirudinea*.

The body is readily divisible into "neck-" and trunk-regions. Along the trunk-region, in the mid-dorsal line, runs a longitudinal groove, extending from the anterior extremity of that region through the greater part of the body, towards the posterior extremity.

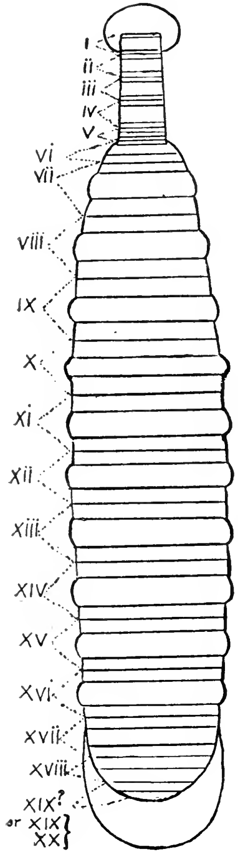

Fig. 1—Diagram of *Pontobdella macrothela*, shewing somitic constitution.

Annuli.—Total number visible on dorsal surface is 55. Of these 16 fall in the neck-region, and 39 in the trunk-region. The annuli are very readily made out with the naked eye, except at the anterior and posterior extremities, where the lines of division are not clearly marked. However, even in these regions, one can count them definitely.

Throughout the greater part of the body the limits of the somites can be seen, each consisting of three annuli, the middle one of which is about double the width of that anterior and posterior to it. The surface of each of the smaller annuli is divided dorsally into eight tubercular areas, four on either side of the mid-line; similarly on the ventral surface where, however, the tubercles are not so pronounced as on the upper surface. The middle annulus of each somite is divided dorsally into six tubercular areas; two very large tubercles on either side of the mid-line, between each of which two is a minute tubercle; ventrally this annulus is also divided into six areas, the two of which lying next the mid-line are not so pronounced as those lying to the outside of them.

In the neck-region the tubercles are well developed (although not so strongly as in the trunk-portion), so that the somites can be readily made out in this region. The last five annuli of the neck are constituted by the last annulus of somite iv. of that region, as made out by noting the annuli visible, three annuli of somite v., and the first annulus of somite vi., which is the most anterior somite of the trunk-region. The middle annulus of somite v. differs in no way, as regards the tubercles, from that anterior or posterior to it.

Somites.—As has been already stated, the somite is triannulate; and the somites can be readily made out, owing to the fact that between any two adjacent small annuli runs a strong transverse sulcus, and this occurs regularly throughout the body. One can safely conclude that this marks off the limits of the somites, and, in accordance with this, the large annuli, provided with their prominent tubercles, constitute the middle and second annulus of a somite. These tubercles correspond to the more typical papillæ in other species of *Pontobdella*, and have the same metameric significance. This, then, is in keeping with Castle's generalisation, that the annulus bearing sensory papillæ constitutes the middle annulus of a somite. There can be no doubt that, in this species, such is proved to be the case; but, as will be shown later, this does not hold in all members of the *Hirudinea*, the sensory annulus really denoting the most anterior of each somite, as suggested by Whitman, in some forms.

The arrangement of the annuli, with regard to somites, as seen in *P. macrothela*, is as follows:—

	Annuli.	Somite.	Nature.
Neck.	1-15	i.-v.	Triannulate.
	16		
Trunk.	17	vi.	Triannulate.
	18		
	19-51	vii.-xvii.	Triannulate.
	52, 53	xviii.	Biannulate.
	54, 55(?)	xix.(?)	Biannulate(?).

From this it will be seen that there is no abbreviation of the somites noticeable at the anterior extremity; and that abbreviation is noticed in somite xviii., where the first annulus is that bearing the large tubercular areas, and having double the width of that anterior and posterior to it.

PONTOBDELLA AUSTRALIENSIS, n.sp. (Plate lvii.)

For the privilege of examining this leech, I am indebted, through Professor Haswell, to Dr. Tidswell. In the collection were about thirteen individuals of the same species, in various conditions of retraction and extension. An examination of these shows how easily mistakes have been made in the creation of new species of this genus, inasmuch as the shape of the body and general habit, and the importance of the papillæ are so different in contracted specimens. In such the otherwise prominent papillæ are hardly noticeable.

In general appearance the species approaches closely to the common European species, *Pontobdella muricata.*

Body.—The shape in various conditions of retraction is shown in Plate lvii.

In an individual with well extended neck the measurements were :—Total length, 20 mm.; neck, 8 mm.(exceedingly slender); breadth of body, 3 mm.; depth of body, 3 mm.

The neck is very strongly attenuated in a state of extension, having a diameter of only 0·5 mm.

Colouration.—In the preserved condition the neck-region is a light yellowish-brown, and the body-region has a blue or bluish-grey colouration. The posterior sucker and the region of a few annuli just anterior to it, have the same light appearance as the neck. No trace of pigmented ornamentation is to be noted in connection with the anterior sucker.

Oral sucker.—Diameter 1 mm. On its margin are borne, on either side of the mid-line, four, sometimes five, pairs of papillæ, the fourth and fifth pairs, that is the posterior two, being usually less strongly developed than the anterior two; and of these, the fourth is larger than the fifth.

On the dorsal surface of the "head," a faint annulation can be made out,

Posterior sucker.—Diameter 1·5 mm. Traces of annuli can be seen on the dorsal surface of this sucker.

Annuli.—Behind the " head," the body is composed of about 55 annuli. The dorsal surface of the posterior sucker is divided, by two faint lines, into three annuli. The dorsal surface of the anterior sucker is marked off faintly into five or six annuli.

Somites.—Throughout the greater part of the body the somites are triannulate, the middle annulus of each being marked off by the presence of prominent conical papillæ. Beyond this, there are no other means, such as one has in *P. macrothela*, for mapping out the somites, inasmuch as the sensory annulus is not more intimately united with any one annulus than with another, and thus the limits of a somite are not so graphically shown. However, since the sensory annulus is shown to be the middle ring of the somite in *P. macrothela* beyond doubt, and it is hardly probable that one would find the middle annulus to be represented by the sensory ring in one species, and the latter to represent the first annulus in another species of the same genus, we may safely conclude that in this species, as in *P. macrothela*, the sensory ring is the middle annulus of the somite. The middle annulus is also slightly longer than that anterior or posterior to it. All the annuli bear papillæ, but these structures are much more strongly developed in the body-region than in the neck-region.

In the body-region the sensory annulus bears six prominent conical papillæ, one on either side of the mid-dorsal line, one on each dorso-lateral margin, and one on each ventro-lateral margin. In addition to these papillæ, there is a smaller papilla, similar to those in the other annuli, on each side of the median ventral line.

The somitic constitution in regard to the annuli, irrespective of those entering into the " head " and " acetabulum," is similar to that in *P. macrothela*, the number of annuli being the same in the body of each.

Note on some parasitic bodies found on P. australiensis.

In the present note, I record the occurrence of an unknown Entoproctous Polyzoon, found in abundance, but in an incomplete condition, on *Pontobdella australiensis.*

The structures which I have identified as Entoprocta, have been previously noted but misinterpreted by Macdonald as spermatophores. Macdonald, in a description of some marine leeches from the tropical region of the Pacific, remarks in connection with a large black leech which he found on a species of *Myliobatis*: "Attached to the body in a very irregular manner, but chiefly at its fore part, were several of the double tubular spermatophora shown in fig. 9. These curious bodies I have also found on other marine *Hirudinei*, but always with some characteristic differences. Fig. 6, for example, represents a small black leech with white tubercles, referable, apparently, to the genus *Pontobdella*, found on *Rhinobatis* in the same seas; and fig. 7 is its double-barrelled spermatophore, which is quite different from fig. 9, though obviously of the same nature. Very little is positively known of the generative processes of the marine leeches; but the facts here mentioned may one day meet with a satisfactory explanation."* Macdonald evidently found these structures on *Branchellion* as well as on *Pontobdella*. I have examined both these genera, but have never yet managed to secure specimens on *Branchellion*, although, no doubt, such do exist on the latter genus as on *Pontobdella*, and according to Macdonald's figures, it is quite possible that another species of the genus exists in the Pacific Ocean. I have examined quite a number of specimens of *Pontobdella australiensis*, which is undoubtedly the same species as that examined by Macdonald, and found a large number of structures which apparently are identical with those seen by Macdonald.

On examining specimens of *Pontobdella australiensis*, attention was drawn to a number of slender whitish bodies attached to the anterior region of the body of the leech, and rendered conspicuous by their abundance and colour.

The papillæ in this leech, as noted above, are very prominent structures if the animal is not dilated or extended excessively; and one might, at first, interpret these bodies as abnormally

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* Trans. Linn. Soc. Zoology. Second Series. Vol ii. p.211(1877).

developed papillæ, the structures themselves being of slightly more importance than the filiform papillæ which occur along the margin of the oral sucker of this species of *Pontobdella*.

Against this idea, was held up the fact that the bodies had no regular arrangement in any one individual. On examination under the microscope, very little assistance can be derived, by means of reflected light, with a view to fixing the exact meaning of these structures. One can readily, however, make out a swollen basal portion measuring 0·1 mm. in diameter, and corresponding to the foot-gland. The structures themselves resemble, in miniature, the leech-host itself in shape, being much attenuated at the distal end, where the calyx would be attached (0·015 mm. in diameter), and thence increasing rapidly towards the proximal end, so that, about mid-length, it measures 0·12 mm. in diameter, and decreases but little till it reaches the foot-gland. The greatest length of any one stalk was 0·72 mm.

No traces of calices were found in connection with any of the stems, and this unfortunate condition prevents one from making any remarks in regard to the generic position of the form. There is, however, every reason to suppose that a new genus is represented by these structures.

Concomitant with the attenuated condition of the distal end of the stalk, is the headless condition of the stalks, so that one may conclude that the calices very readily break away; and, further, that, in all probability, regeneration does not take place. The stem of all Entoproctous Polyzoa has a musculature which is characteristic, so that the difficulty of drawing any definite conclusion of systematic value is enhanced. However, the habitat of the form, and the fact that the form is a solitary species, enable one to conclude, with some reason, that it has some affinity with *Loxosoma*, which is a solitary form, and is found on Annulates, although I can find no mention of its having been found in association with any member of the Hirudinea. In *Loxosoma*, however, the line of demarcation between body and stalk is not well defined, the characters of the genus being given by Hincks as "Polypides pedunculate, solitary, the body closely united to the stem, and not deciduous." The foot-gland for attachment, rendered necessary by the absence of any adherent stolon, though frequently absent in the adult, is always present in the young, and in the forms under consideration is conspicously developed as a trumpet-like disc. Judging from the small size of the stalk in all the individuals I have examined, it is very probable that they are all very young.

GEOBDELLA TRISTRIATA, sp. nov.

A specimen of this leech was obtained in the Fife Bay district, British New Guinea; and for permission to examine it, I must express my thanks to Thomas Steel, Esq. In this region it is known to the natives under the name "Domani." I have no further information in regard to its habitat, but consider it quite safe to conclude that it is a land-leech, as in the case of the only two other species which are at present known as representatives of the genus *Geobdella.* Its occurrence in New Guinea is of some interest, inasmuch as the genus is otherwise confined to Australia, *G. Whitmani* being known in New South Wales and Queensland, and *G. australiensis* from New South Wales. As far as I know, *Geobdella* has not been yet found in Victoria or Tasmania. No better place could be found for the requirements for an abundance of land-leeches than moist tropical and subtropical spots, and it may be that the genus under description may be confined, more or less, to such localities. I mention this in regard to the limited distribution, because land-leeches are such prominent and easily detected animals, that it is hardly likely that in the well explored Southern State they would escape detection.

The single specimen is preserved in alcohol, and as such in the contracted condition resembles in shape *G. Whitmani* and *G. australiensis*; length, 16 mm; breadth, 4·3 mm; depth, 2mm; posterior sucker, 3mm. in diameter.

Seen with the naked eye, the surface has a papillose, rugose appearance, as is the case in *G. Whitmani*, the only other species I have been enabled to examine. When examined under a lens, these papillose structures are very marked, giving the surfaces, especially the dorsal, a very marked rugose character. The colouration differs from that in the other species. In the preserved state the ground-colour is light yellowish-brown. On the dorsal surface are two irregularly outlined dark pigment-bands, one on either side of a median clear area, extending from the level of the fourth pair of eyes as far back as the posterior extremity, with slight interruptions at intervals in the posterior third of the body. On the ventral surface are present three straight dark bands, one median and one at either margin of the ventral surface, the former extending practically from the posterior lip of the oral sucker to the posterior extremity, the latter along the posterior two-thirds of the body.

The *oral sucker* is composed by annuli 1, 2, 3, and 4 partly.

The *lower lip* is composed by annuli 4, 5, 6, and 7, if one notes the incomplete annuli on the ventral surface, but really by annuli 4 and 5, the latter composition agreeing with other species of *Geobdella.*

Genital Apertures—The apertures cannot be made out in the single specimen, owing to the manner in which the ventral surface is buckled, due to contraction.

Annuli.—As in the other species of *Geobdella*, the annuli are 95 in number. On the dorsal surface, the first complete annulus is the fifth(5th), just behind that bearing the fourth pair of eyes, inasmuch as it is the most anterior annulus running to the margin. Annuli 2, 3, 4 are readily made out between the eyes, but can be only faintly made out laterally to the eyes, this being due merely to the fact that the tubercular nature of the rugose surface makes the limits of the annuli fairly readily visible, although marked lines of division cannot be made out so plainly as in the case of succeeding annuli.

On the ventral surface the first complete annulus is the eighth (8th). Annuli 4, 5, 6, and 7 become more and more developed as one passes backwards, so that 7 is more nearly complete than those lying anterior to it.

Somites.—The unabbreviated somite consists of five(5) annuli, a number which is apparently constant in the genus.

There are present no sensillæ in the preserved specimen, so that one has no guide to the metameric constitution of the species from external examination by means of the sense-organs,

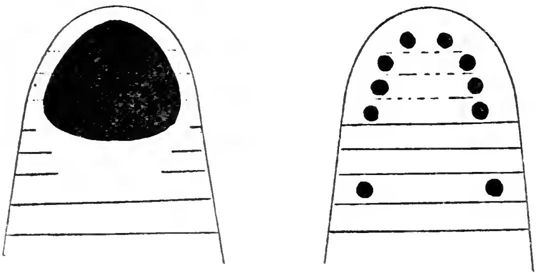

Fig. 2.—Diagrams of anterior extremity of *Geobdella tristriata*, sp.nov.; ventral and dorsal.

except at the anterior extremity, where one can do so where one can draw conclusions from the position of the eyes. However, as the number of annuli is exactly the same in all species of *Geobdella*, one may safely conclude that the somitic constitution of the body is the same in this species as in those in which it can be made out by means of the sensillæ. It is quite possible (and indeed quite likely) that sensillæ are present in the species, and could be made out in a well fixed specimen. Both *G. Whitmani* and *G. australiensis* bear sensillæ.

According to Whitman's method of determining somite-limits, by assuming that the sensillæ denote the first annulus of a true segment, the constitution of the body in which sensillæ can be made out, is as follows:—

Somite	i.	Annuli	1.	Constitution	Uniannulate.
,,	ii.	,,	2.	,,	Uniannulate.
,,	iii.	,,	3.	,,	Uniannulate.
,,	iv.	,,	4,5,6.	,,	Triannulate.
,,	v.	,,	7,8,9.	,,	Triannulate.
,,	vi.	,,	10,11,12.	,,	Triannulate.
,,	vii.-xxii.	,,	13-92.	,,	Pentannulate.
,,	xxiii.-xxxiv.	,,	93,94,95 + acetabulum.	,,	Abbreviated.

There is every reason to believe that this same constitution holds in the case of *Geobdella.* Castles, in his excellent work, has laid down the following generalisation in regard to the metameric significance of sensillæ, namely, that the sensory ring occupies the middle of the somite.

In examining the present species for sensillæ, I found, under contraction due to the action of the killing fluid(alcohol), that there were strongly marked divisions regularly arranged, on the ventral surface. In examining these carefully, I found that each division consisted of five(5) annuli, and, by this means, I used a count of the annuli to see how these divisions would correspond with those into which the body would fall by using Whitman's or Castle's method, respectively, in conjunction with the assistance rendered by an examination of the markedly sensilliferous species, *G. Whitmani.* The result was that they corresponded exactly with that laid down in the table given above.

It would certainly seem to denote that, in this genus, the sensillæ mark off the first annulus of a somite. It is quite possible that there is no constancy in regard to the position occupied in a somite by the sensilliferous annuli in leeches in general, but it may be always the same in the same genus, as in *Glossiphonia*, for instance, where, no doubt, the sensilliferous annulus is the middle one of the triannulate somite. I have pointed out in a previous paper, in connection with the description of the genus *Semilageneta*, the impossibility of allotting the annuli in the manner suggested by Castle, for that genus.

That variation takes place among the sensillæ can be seen in *Glossiphonia heteroclita*, in which the eyes are usually situated on annuli 5, 7, 8, and at other times on annuli 6, 7, 8; and the eyes are really modified sensillæ, and have the same metameric significance.

EXPLANATION OF PLATES LVI.-LVIII.

Plate lvi.—*Pontobdella macrothela* Schmarda.

Fig. 1.—Ventral view.
Fig. 2.—Dorsal view.

Plate lvii.—*Pontobdella australiensis*, n.sp.

Fig. 1.—The body distended.
Fig. 2.—The body extended.

Plate lviii.—*Geobdella tristriata*, n.sp.

Fig. 1.—Dorsal view.
Fig. 2.—Ventral view.

THE TIN-DEPOSITS OF NEW ENGLAND, N.S.W.

Part i.—The Elsmore-Tingha District.

By Leo A. Cotton, B.A., B.Sc., Linnean Macleay Fellow of the Society in Geology.

(Plates lix.-lxiv.)

CONTENTS.

Chapter i.—Introduction.

Tin-mining in New South Wales is chiefly carried on in the New England District, which comprises the Northern Tableland. There are two well defined tin-bearing areas, one having Emmaville as its centre, and the other embracing the country about Tingha. These are separated by a barren tract consisting of a series of slates and claystones largely covered by basalts. This unprofitable zone is some 20 to 30 miles in width, and has been worked for tin only in the neighbourhood of Wellingrove. Both tin-bearing areas are associated with granite and allied rocks.

The geology of the Emmaville district has been investigated in detail by Professor David, and the results of his work constitute a valuable memoir published by the Geological Survey of New South Wales.*

The same gentleman has also contributed to our knowledge of the Tingha district, and the map published by the Mines Department of New South Wales, from a partial geological survey by Wilkinson and David, has been of much assistance to me in my study of this field.

A later writer, Mr. E. E. Andrews,† also of the Geological Survey of New South Wales, has also contributed a series of papers embracing both areas, and has studied the ore-deposits more from a genetic standpoint.

A few useful observations on these New England tin-deposits were made by Mr. G. H. F. Ulrich‡ shortly after their discovery, but, with this exception, practically all the work that has been done has been accomplished by officers of the Geological Survey.

My experience has so far been limited to the Tingha area, and the observations made in this paper refer to that district. No attempt will be made here to explain in any detail the genesis of the ore-deposits; as it is rather my intention to collect as much evidence as possible from other occurrences and laboratory investigation before discussing at any length the question of origin. The contents of this paper, then, consist of a brief record of the observations made during a four months' study in the Tingha

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*David, T. W. E., "Geology of the Vegetable Creek Tin-Mining Field." Mem. Geol. Survey New South Wales. Geology, No. 1 (1887).

†Andrews, E. C., "The Geology of the New England Plateau.—Part i., Physiography"; Records Geol. Surv. New South Wales, Vol. vii. p. 281, 1904; Parts ii. and iii., with special reference to the Granites of Northern New England; *op. cit.* Vol. viii., p. 108, 1905; Part iv., Petrology, *op. cit.* p 196, 1907; Part v., Additional Notes on the Origin of New England Ore Deposits, *op. cit.* p. 239, 1907.

‡ Ulrich, G. H. F., "Observations on some of the recent Tin-Ore Discoveries in New England, New South Wales." Quart. Journ. Geol. Soc. Vol. xxix., p. 5, 1873.

area. The observations are grouped and correlated, as, it is hoped, will best serve as a basis for a genetic discussion later on.

Geography.

Tingha is situated about 16 miles south by east from Inverell, and may be reached by coach from that town. Elsmore lies some 12 miles north by east from Tingha, on the Inverell to Glen Innes mail coach route. Most of the tin-bearing country lies between the latitudes fixed by these two towns, though tin has been found in small quantities some miles south of Tingha. The area found to be tin-bearing is represented on the accompanying map, and its extent may be roughly estimated at about 300 square miles. The drainage of the area conforms to two river-systems, the Macintyre and the Gwydir, which form respectively its northern and western boundaries. The Inverell-Armidale road runs along the ridge forming the watershed of these rivers.

Topography.

It is necessary under this head to anticipate the section on geology to the extent of stating that the geological units consist of slates and claystones, granites, and basalts. Each of these units give rise to a characteristic topography and vegetation.

The slates and claystones are much metamorphosed, and resist very strongly the attacks of weathering. Consequently, they stand out as high, rugged ridges, and are scored with steep gullies. They are invariably strongly jointed, and weather into sharp, angular fragments which make travelling difficult.

The granites, though varied in structure and composition, present a uniform set of topographical characteristics. Huge tors and piles of granite-boulders are common throughout this granite-area. The boulders present a general ellipsoidal appearance with their long axes vertical, and are, as a rule, somewhat flattened on the south side. Several very interesting sketches of these are given in "Mines and Mineral Statistics of New South Wales" published by the Department of Mines in 1875.

The granite hills are more rounded and less precipitous than those in the slate country, and usually more soil is present. It is not uncommon, however, to find very large areas of bare rock generally steeply sloping on the side of a hill. (See Plate lix., fig. 1). This is a very prominent characteristic of the granite hills at Howell. Here, many of the hillsides consist of clean bare rock of a reddish color, and the whole presents a most striking appearance. This feature I have always observed to be developed on the northern slopes of the hills, where changes of temperature and rock-disintegration are most rapid.

The coarser-grained types of granite are more prone to decomposition than those of finer grain, and hence the higher granite hills are usually of the latter kind. The porphyritic granite is the most prone to decomposition, the phenocrysts becoming dislodged, before being appreciably decomposed, by the disintegration of the finer matrix surrounding them.

The basalts constitute the youngest rocks, are seen to overlie slate and granite alike, and to fill in the pre-basaltic valleys and watercourses. There is considerable variety in the basalts, and the relative resistance to weathering of consecutive flows frequently gives rise to a terrace-like structure on the slopes of the basalt-hills. This is well developed in the neighbourhood of Elsmore. Conical basalt-knobs are not infrequent, but are much rarer than in most volcanic areas. A much more common feature is the very striking development of long level-topped ridges of basalt terminating rather abruptly in steeply sloping ends. This suggests that the outpourings of the lavas are related to fissures rather than to foci of eruption.

The river-system is consequent. The fall in the general surface of the country is to the west, the rate of fall being about 1000 feet in 30 miles. One marked feature is the development of the streams along the junction of geological formations and lines of structural weakness. Streams have been noticed flowing for quite a distance along, or close to and parallel with, the junctions of granite and basalt, of basalt and slate, and also of slate and granite. The pre-basaltic stream-courses were subject to the same preferential development, many junctions of granite and slate being now obscured by basalt filling the ancient valleys between these older formations. Several interesting cases were also observed where the direction of the streams has been determined by faults, and in some cases the master-joints have been sufficiently well developed to produce a similar result.

Chapter ii.—Geology.

It will be convenient, here, to make reference to the plan of the accompanying geological map, which is somewhat unusual. The lode tin-deposits are associated with the older rocks of the district, and have no genetic relations with the basalts, which are much younger. Hence, it was considered best to construct a geological map showing only such rocks as are concerned in the origin of the ore-deposits. This plan necessarily makes the geological map rather general, as the boundaries of the older formations have to be approximated to where they are concealed by the overlying basalt. Nevertheless the boundaries may be accepted with confidence as close approximations. Much of the information, more especially with regard to the granite and slate boundaries, has been very kindly furnished by officers of the Department of Mines working in the same area. Where the boundaries are shown in continuous lines, they have been accurately determined, either by the officers of the Department of Mines, or by myself. The broken lines represent that the boundaries have been approximated to by numerous observations. I have made a study of the two granite-types indicated on the map, and in many places have traversed the contacts. Only those ore-deposits which are specially mentioned in this paper, are shown on the map. The work done on scores of smaller ore-bodies has been condensed and generalised under the descriptions of the different types of deposits. The dotted areas indicate those in which tin has been found, and the density of the dotting is intended to convey an idea of the concentration of the cassiterite.

Two sections accompany the geolcgical map. These, it should be remembered, are drawn in harmony with the plan of the map, and hence do not show the necks and fissures which served as outlets for the Tertiary lavas. The sections will, it is hoped, make clear the intrusive nature of the "Acid Granite," and its close association with the ore-deposits.

The general geology of the area to be considered may be represented by three units:—

(1). A series of altered sediments.

(2). A series of granites and allied rocks.

(3). A series of basalts and allied rocks.

Age of the Rocks.

The complete failure of all investigators, up to the present time, to find any fossils in the sedimentary rocks, makes a definite statement of their geological age impossible. Any provisional age assigned to this series must rest upon such evidence as lithological characters and continuity with, or proximity to, rocks of known geological age. Lithologically, these sediments, which consist of slates and claystones, appear to me very similar to rocks of Ordovician age occurring both at Berridale and Tallong. The New England sedimentary rocks, however, appear to be more metamorphosed, so much so in fact, that at no place was I able to obtain reliable dips for the strata. In qualification of this statement it is only proper to remark that no place investigated was distant more than three miles from an igneous contact.

The slates cannot be traced continuously into rocks of known geological age, neither are there any similar rocks of known geological age in close proximity. The series has previously been provisionally classed as Carboniferous on the evidence contained in the following statement from Mr. Gower's report of 1874, to the Department of Mines:—"On Newstead Station, thin bedded shales of bluish-grey and yellow colour crop out, dipping at an angle of 15° in one place and almost vertical in the other, with a general northerly strike. I could not detect any fossils in them, but from their lithological character there is little doubt but that they form part of the carboniferous formation of which the Rev. Mr. Clarke's report states: 'that the middle beds of this formation, those of the Hunter and Hawkesbury, are widely distributed on the western border of the country between New England and the interior.'"

Unfortunately I have not seen the occurrence thus described by Mr. Gower, though I am well acquainted with Newstead. There can be no doubt, however, that the occurrence, so far from being typical of the sedimentary formations in this district, is most exceptional. The nearest related rocks are those described by Professor David from Vegetable Creek. In these he found rather obscure fossil remains, and has concluded that the series is Upper Silurian or Siluro-Devonian.

Another point in favour of the geological antiquity of the rocks is the occurrence in them of ore-bodies other than tin. At "The Brothers," near Newstead, a small reef was opened up for silver and lead, and similar bodies of galena and arseno-pyrite are common in the slates about eight miles south of Tingha. Hence lithological characters favour a correlation with Ordovician and Silurian rocks, and the system may provisionally be classed as Silurian.

The age of the granites must, on this basis of classification, be regarded as Post-Silurian, as evidence of their intrusion into the slates is abundant. Professor David has classed the intrusive tin-bearing granite at Emmaville as Permian, for the following reasons. (1) It may be correlated with the granite which has intruded the Permo-Carboniferous rocks at Ashford. (2) No granites in New South Wales have appreciably disturbed Triassic rocks.

Another fact in confirmation of this proposed age for the granites, is the statement by the Rev. W. B. Clarke* that "geologists at Home have settled it that the stanniferous granites are Palæozoic, Pre-Permian, and Post-Silurian."

Again Mr. David Forbes† said at the Geological Society's meeting in December, 1871, that he had received specimens of the granite from the New South Wales tin-region, in the year 1859, and that he found them to be "perfectly identical with the stanniferous granites of Cornwall, Spain, Portugal, Bolivia, Peru, and Malacca."

*Mines and Mineral Districts of New South Wales, 1875, p. 86.
†*Ibid.*

From these considerations, then, it is highly probable that the granites are of Permian age.

The Basalts present clear evidence of Tertiary age. At Elsmore there is, interbedded with the basalts, a bed of clay-ironstone, in which abundant plant-remains are to be found. This bed may be traced some three miles both to the north and east of Elsmore. Numerous aneroid determinations indicate that this horizon preserves a constant level, and the inference is that it was formed as a swamp or lake-deposit. The forms collected were kindly identified by Mr. W. S. Dun, and proved to be *Cinnamomum* sp., *Artocarpidium Gregorii* Ett., *Quercus (?)* cf. *Darwinii* Ett., *Cinnamomum* sp., a leaf like Ettingshausen's *Alnus*, *Cinnamomum* cf. *polymorphoides* McCoy, *Carpolithes*, *Cinnamomum polymorphoides*, and (?) Ettingshausen's *Eucalyptus*.

Another collection of fossil leaves from the Elsmore Valley Deep Lead, some 300 feet lower than the horizon above-mentioned, was also examined by Mr. Dun. The following forms were determined—*Banksia myricæfolia* Ett., *Cinnamomum Leichhardtii* Ett., *Eucalyptus Diemenii* Ett., *Cinnamomum (?)*, *Ficus (?)*, *Dryandra præformosa* Ett., and *Ficus* cf. *Phillipsii* Ett. Similar fossil leaves and Unio shells were collected from Elsmore some years ago by Mr. Wilkinson, and these were identified as belonging to the late Tertiary period.

A consideration of the foregoing facts has led to the following classification, in which the positions assigned to the various formations have been determined by their relations to the slates, granites, and basalts.

RECENT		Allvuials
TERTIARY		Basalts Calcareous and Siliceous Deposits
PALÆOZOIC	Permian	Dykes The "Acid Granite" The Tingha Granite
	Silurian	Slates and Claystones
UNDETERMINED		Quartz-Porphyry Felspar-Porphyry Quartz Orthoclase Porphyry

The Silurian System.

The oldest rocks are undoubtedly the slates and claystones, which are so widely distributed over New England. All attempts to find fossils in the field have proved unsuccessful, and microscopic investigations have failed to reveal any trace of organic remains.

The slates vary in colour from dark blue to green, and are very fine-grained. A freshly broken piece may very readily be mistaken for a fine-grained basalt. They occur in masses frequently surrounded by igneous rocks, and exhibit signs of intense metamorphism.

At Newstead, the contact of the eastern side of the tin-bearing granite with the slate has given rise to a great development of garnet-rock. The slate here is green in colour, with brown streaks and aggregates of fine brown garnet.

Again, at the contact of granite and slate, at a point about five miles west from Tingha, a mica-schist is developed containing crystals of garnet up to 3mm. in diameter. The intrusive granite in this locality is the Tingha Granite.

The evidences of the intrusion of the granite into the slate are (1) Contact-metamorphism, (2) Veins and dykes of granite in the slate, (3) Inclusions of slate in the granite.

The development of garnet-rock above mentioned is evidence of contact-metamorphism; another evidence is the common development of quartzite in the slates near the igneous contacts.

An excellent example of an intrusive dyke of granite into slate is to be seen in the bed of Darby's Branch Creek at the north-west corner of Portion 214, Parish of Cope's Creek. Here, a tongue of the granite, about two feet in width and several yards long, has intruded a typical slate-mass. One specially noticeable feature is the very sharp contact between the granite and slate. There is no trace whatever of any zone of digested rock. This is worthy of note in support of the application of Daly's theory of overhead stoping to this area. The very marked rectilinear contact also favours this explanation. The intrusive granite is here strongly tourmaline-bearing, this being a characteristic of the numerous smaller veins which also intersect the slate. A sketch of this is given in text-fig. 1.

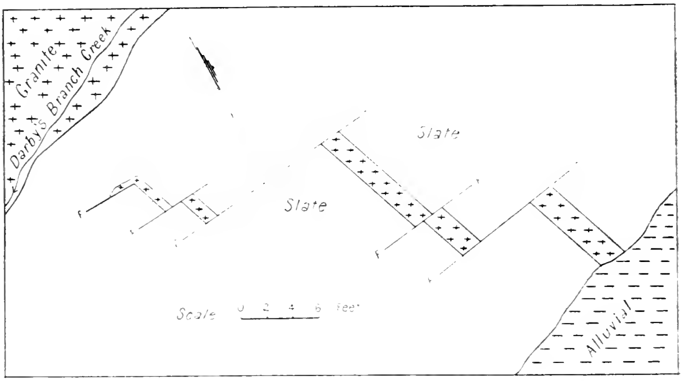

Fig. 1.—Plan of "Acid Granite" intrusion into slate. F, F, faults.

At King's Gap, on the Inverell-Bundara Road, there is another contact of granite and slate. The slate here is converted into a mica-schist, a number of subangular fragments of which may be seen as inclusions in the granite.

The Permian System.

Under this system have been included the intrusive granites. These fall naturally into two groups, namely—(1) The "Acid Granite" (of Andrews). (2) The Tingha Granite.

Of these two types, it is the "Acid Granite" which is closely associated with the tin-deposits. The most primitive distinction between these two granites is, that the "Acid Granite" is a red granite, and the Tingha Granite a blue granite. The latter type is not, however, the same as that named the "Blue Granite" by Mr. E. C. Andrews, and which occurs in another part of New England.

The Tingha Granite.—Of the two granites, the Tingha Granite is certainly the older, as it has been found in many places to have been intruded by the "Acid Granite." The contact is never very sharp, a zone of rock intermediate in composition being usually present. In some instances, as at King's Gap, for example, fragments of the Tingha Granite may be seen included in the "Acid Granite."

The Tingha Granite is typically developed around Tingha, chiefly to the south of Cope's Creek. A glance at the accompanying map shows its extent. It is characteristically a porphyritic granite, the phenocrysts being felspars and quartz. The felspars are chiefly plagioclases, and may be seen rather more than an inch in length, though typically they form almost square crystals, about half an inch in length. A considerable amount of biotite, and an almost equal quantity of hornblende are present. Apatite is an accessory mineral. The quartz grains are seldom larger than a pea, and are less numerous than the felspar phenocrysts. The ground-mass consists of a second generation of felspar and quartz. The felspar phenocrysts cause the rock to present a striking appearance on weathering. It is remarkable that the felspars, usually so prone to decomposition, stand out in bold relief, often projecting a quarter of an inch or more above the surface of the rock. This is due, no doubt, to the more rapid weathering of the second generation of felspars, causing the rock to disintegrate round the phenocrysts.

This granite occupies a considerable area, and was the first to intrude the sedimentary rocks. An isolated area of it occurs in the neighbourhood of Copeton, and extends a few miles to the north of that town. This granite is represented by Plate lix., fig. 2. A somewhat similar granite, which may be regarded as an allied type, is the *Oakey Creek Granite.* This rock extends from near the Inverell to Copeton Road, for a considerable distance to the west. It is extremely porphyritic, the felspars attaining a length of nearly three inches in rare cases. The average size is considerably more than an inch in length. Pegmatite veins are common, and dykes of a fine-grained felspathic nature containing a good deal of tourmaline are also abundant. Quartz veins containing large prismatic crystals of tourmaline are also to be found.

Stream-tin has been discovered in small quantities throughout the area, but no lodes have been worked. The cassiterite has been recovered chiefly from the diamond-bearing gravels of Tertiary age, which have been preserved by cappings of basalt.

A further modification of the Tingha Granite occurs a few miles to the south of Tingha. The difference is, however, mainly one of texture. No phenocysts are present, and the granite is rather fine-grained.

The "Acid Granite."—This granite varies considerably in texture, but very little in structure and composition. At Elsmore the granite is rather coarsely crystalline, the crystals being about the size of a pea. The rock is here composed almost entirely of quartz and felspar. The felspar is predominantly orthoclase, while albite is present in small quantity. The quartz-crystals are frequently more or less idiomorphic, and micrographic intergrowth of quartz and felspar is common. Occasionally the granite takes on a porphyritic habit, the felspars attaining a length of about an inch. A very small amount of biotite and magnetite are usually present, but in places even this is wanting. The granite has a reddish colour. It is worthy of note, in this connection, that the tin-bearing granite of the Waterberg District in the Transvaal has been named the "Red Granite." (See Plate lx., fig. 2.)

The granite near Auburn Vale is similar to that at Elsmore; rather more biotite is present; and a fine-grained modification of it occurs. Micrographic intergrowth of quartz and felspar are also very common.

The granite at Howell is similar to the coarse type at Auburn Vale; and the same type of rock occurs again intruding the Tingha Granite at King's Gap. (See Plate lx., fig. 3.)

A modification of the "Acid Granite" occurs as an intrusion into the Tingha Granite, about four miles south of Tingha. Here the granite, while possessing the usual characteristics of the "Acid Granite," contains a good deal of microcline. It is in this belt that Hong Hay's Pipe occurs.

Another modification of the "Acid Granite" occurs at, and near Tingha. This type occurs in small patches only, and is notably tourmaline-bearing. It is miarolitic, the drusy cavities being lined with quartz and tourmaline crystals. A fine exposure is to be seen in the bed of Murray's Water, about a mile from its junction with Cope's Creek.

One noteworthy feature of the "Acid Granite" is, that it frequently occurs at the contact of the older Tingha Granite and the slates. Indeed, if the accompanying geological map be examined, it will be noticed that the large body of the "Acid Granite," is wedged between the slates on the north and the Tingha Granite on the south. In some places the margin of the slates is separated from the Tingha Granite by a belt of "Acid Granite," a score or so of yards in width. This marginal distribution of the "Acid Granite" is doubtless due to the fact that the contact of the older formations was a surface of structural weakness; and that the "Acid Granite," taking advantage of this, was able to rise, and, by stoping and pressure, to considerably increase its extent.

Aplitic Dykes.—Closely following on the consolidation of the "Acid Granite," a number of aplitic dykes were forced into the granite-systems. These are best observed in the neighbourhood of Oakey Creek and Copeton, because here numerous adits have been driven into the granite hills for the purpose of working the diamond-bearing gravels. The dykes are fine-grained quartz-felspar rocks, and are frequently strongly tourmaline-bearing. In several localities where these have been exposed by weathering, the stock and native animals have worn bare and smooth, many square yards by licking the rock, which evidently contains some palatable constituent. The dykes weather to a soft milk-white friable rock of a highly felspathic nature.

(b) *Felsite-Dykes.*—At Copeton, about half-way between the Post Office and the Public School, a dyke of felsite may be seen crossing the race from the "Star of the South" diamond-mine. The rock is greenish in colour, and is felsitic in structure. A similar dyke passes through the "Banker" diamond-mine, and may be traced for at least half a mile on the surface.

(c) *Dolerite-Dykes.*—In the same locality a coarse dolerite-dyke has been found. This is situated on Oakey Creek and has been found to be diamond-bearing. It is not quite certain whether the occurrence is a pipe or a dyke, but there can be no doubt that this interesting rock is a true diamond-matrix. Several other rather similar occurrences have been observed, but need further investigation.

The Tertiary Rocks.

Siliceous Springs—After the final intrusions of the "Acid Granites," a long period of quiescence prevailed, during which denudation and stream-action profoundly modified the topography. Many tin-bearing reefs were disintegrated, and their metallic contents concentrated in the valleys and watercourses. At length the time was ripe for the initiation of another cycle of igneous activity. This period of Tertiary vulcanism was ushered in by the development of siliceous springs. The effect of these is evident on every hand. At Newstead, perhaps, the most striking effects are to be seen. Here, on the eastern slope of the granite hill, there occurs a very hard and highly siliceous rock covering an area of some acres. This is locally known as "The Glassy Bar." It is of no great thickness, usually from 3 to 10 feet, and invariably overlies the normal granite. It occurs casing the present slope of the hill to a height of about 100 feet above Newstead Creek. It is a very compact rock, consisting entirely of fine-grained quartz-granules firmly cemented by silica. At a little distance from, and higher than the "Glassy Bar," a shaft was sunk on an outcrop of quartz. The shaft was continued for some distance on the same type of quartz, which did not present any resemblance to a lode. Fine crystals of cassiterite were found included in the quartz, which was rather glassy in appearance. A few yards to the west another shaft was sunk on a dark, almost black-looking quartz. I am of the opinion that the cassiterite contained in the quartz was not derived from an extraneous source, but that it crystallised from the siliceous solution. This massive quartz-structure rises through the solid granite massif.

About half a mile to the west of these shafts, a most interesting occurrence of cemented conglomerate is to be seen.

It is known as the "Karoola Cemented Run." This was a prebasaltic stream running in a northerly direction, and has been traced from the granite-hill at Newstead, for about half a mile to the north, where it ends abruptly. This channel was, in places, exceptionally rich in cassiterite, but the very hard nature of the cementing silica rendered it difficult to work economically. It appears probable that the silica which is responsible for the formation of the "Glassy Bar" and the "Karoola Cemented Run," had its origin in thermal springs issuing from rather large channels in the granite.

In several other localities, namely Elsmore, Topper's Mountain, Stannifer, on the Inverell to Armidale Road east of Stannifer, and at the Lion Lode, I have seen similar cemented drifts. The rock found in these places is a hard grit consisting of quartz-grains, from 2 to 5 mm. in diameter, cemented by silica. Frequently a considerable amount of iron oxide is present in the cementing material. In the proximity of reefs, this rock is often rich enough in cassiterite to pay for extraction, and at Elsmore a quantity of the rock has been treated. Here I have studied the deposit in some detail, and have found that the rock is normally an even-grained compact rock, the grains of which are of the same size as those in the underlying and adjacent granite; the grains are not at all waterworn. In places the rock is rendered porphyritic by the inclusion of large angular fragments of reef-material. Several tin-bearing reefs were noted in this rock. Thus, while the nature of the cemented rock, with its cassiterite-content, indicates its age as younger than the "Acid Granite." the presence in it of the tin-bearing reefs points to the opposite conclusion. The explanation of this is, that the cemented rock has been formed from the residual quartz resulting from the decomposition of granite *in situ*. The reefs in the granite, being composed chiefly of quartz, are very resistant, and have remained practically intact in some cases; while the felspar in the surrounding granite decomposed, leaving only a residue of quartz-grains for a depth of several feet.

In many cases these deposits are overlaid by basalts, and the cementing may have been accomplished by the squeezing out of magmatic water from the basalt on cooling. At all events, the process worked on a disintegrated rock, and from above downwards; for frequently only the upper portion has been cemented, while a similar uncemented rock exists below. This is well shown in Plate lx., fig. 1.

Calcareous Springs.—Amongst the earliest phases of volcanic activity was the development of calcareous springs. Deposits of lime-carbonate from these have been found in several localities. These occur lying on the bed-rock (either granite or slate), and not disintegrated with the basalts.

The next product of vulcanism seems to have been an ejection of mud. There occurs in many places a very red clay, which underlies the oldest basalt. That this is not a decomposition-product of a basalt-flow *in situ*, is shown by the fact that, at Newstead, a fragment of gum was found embedded in the clay.

The Basalts.—Closely following this mud-deposit came the first outpouring of the basalts. This manifestation was widespread over the greater part of New England.

From the fact that the lavas have covered the older river-courses of the "Cañon Cycle," it is evident that the basalts were extruded at the close of the period of uplift which gave rise to this cycle. The period of uplift which elapsed between the formation of the "Stannifer Peneplain," of Andrews, and the extrusion of the basalts was far greater than that between the latter and the present day. This follows from the fact that, in most places, erosion has not yet been sufficient to expose the deep leads, even where the streams have been working in basalt. The orogenic movements which caused the uplift of the "Stannifer Peneplain" were probably responsible for the fractures through which the basalts were extruded.

After the first outburst, a period of rest ensued, during which erosion was active. That the period of rest following the earlier basalts was a considerable one, may be gathered from the following—At Elsmore a series of clays and lignites, filling a broad valley and extending for some miles, have been formed by the denudation of the earlier lavas. This series has been shown to attain a thickness of about 200 feet.

This period of quiescence was followed by another outpouring of lava which buried swamps and marshes, and so preserved abundant plant-remains.

Both periods of volcanic activity gave rise to numerous separate flows of lava. No less than eight flows can be distinguished in the neighbourhood of Elsmore.

Recent Alluvials.—The alluvial deposits lie naturally along the present watercourses. The extrusion of the basalts filled the main valleys developed in the "Cañon Cycle," and as the streams have not yet had time to mature, there are, in consequence, no large alluvial deposits. Dredging is vigorously carried on along the beds of the creeks, but the payable ground is seldom 100 yards in width. The depth of alluvial is rarely more than 40 feet, while the tin-bearing portion is seldom as many inches in thickness. Nevertheless, it is from these recent alluvials that the great bulk of the New England tin has been won.

Rocks of Undetermined Age.

Quartz-Porphyry.—Flanking the eastern margin of the tin-bearing district, there has been found, in several places, a typical quartz-porphyry. The junction of the rock with the granites and slates was unfortunately covered by basalt wherever observed; hence its age cannot be determined from its relation to these rocks. The trend of this belt is, as may be seen from the map, nearly north and south.

Felspar-Porphyry.—The quartz-porphyry just mentioned, is bordered partly on its eastern side by a related, but quite distinct, type of rock. This rock is a felspar-porphyry, quartz being almost entirely absent The phenocrysts are plagioclases of about 2 mm. in diameter. It is best developed in the neighbourhood of Wandsworth.

Quartz-Orthoclase-Porphyry.—Still further to the east, a very striking quartz-orthoclase-porphyry was observed. The orthoclase-crystals are of a pink colour, and are from 2 to 3 mm. in length.

The rock was noted as far north as Glen Innes, and as far south as Guyra; and it is probable that it forms a continuous belt running in a north and south direction. It was shown, in a former paper,* to be intrusive into the slates near Guyra.

The three rocks above mentioned are certainly older than the Tertiary basalts; and are probably also older than the Tingha Granite, and younger than the slates.

Chapter iii.—The Tin-ore Deposits.

The Tin-Ore Deposits.

The deposits map be grouped into three classes as follows—

(1). The Alluvial Deposits.

(2). The Deep Leads.

(3). The Vein-Formations (including Stockworks and Impregnations.

(1-2) *The Alluvial Deposits and Deep Leads* are being studied in detail by the officers of the Department of Mines. Consequently only such mention of these will be made, as is necessary to indicate the distribution of the tin-deposits. Alluvial tin has been found at Elsmore, Newstead, Stannifer, Gilgai, Tingha, Howell, Copeton, Oakey Creek and Auburn Vale. Deep leads have been worked at Elsmore, Newstead, Stannifer, Tingha, Gilgai, Copeton, and Oakey Creek. At the two last-mentioned places, tin has been recovered in connection with diamond-mining.

(3) *The Vein-Formations.*—At all the localities aforementioned, the tin occurs as cassiterite, and has been derived from the vein-formations. The tin-deposits are intimately related to the "Acid Granite," numerous deposits having demonstrated that these ore-bodies occur normally at, or near, the junction of this rock with either the Tingha Granite, or the slates. Those occurrences distant from these junctions occupy the crests of the granite-ranges, and were probably close to their contact with the overlying slates, which have been removed by denudation. This

* Cotton, Leo A , "Note on the Guyra Lagoon." These Proceedings, 1909, p. 233.

preferential concentration of metallic contents near contacts, is a feature which has been observed in many other parts of the world. Of the occurrence at Vegetable Creek, Professor David* has written: "On consulting the geological map accompanying this report it will be noticed that the commencement of most of the veins is situated near the junction of the claystone with the intrusive granite, so that the upward limit of the veins may be said to be the bottom of the claystone and top of the granite. The map also shows that, as a rule, the granite at a distance of over $1\frac{1}{4}$ mile from its junction with the claystone ceases to be tin-bearing."

In commenting on this statement with regard to its application to the Stanthorpe area in Queensland, Mr. Skertchly† says: "The tin-bearing beds are here shown to be the slates near the granite junction, and just those parts of the granite which were assuredly once covered with slate, and, moreover, by far the larger area of the granite where it is coarsely crystalline and must have solidified at great depth under great pressure, is barren of tin. The acknowledged richness of the country on either side of the junction of the granite and slate must be admitted, and it is no argument against this view that in the Stanthorpe area the richest deposits are often many miles from the boundary, unless it can be shown that the slates never existed there."

Mr. E. C. Andrews‡ dealing with the New England tin-ore deposits remarks with regard to them that "The ores in almost every important example are arranged peripherally with respect to the acid granite massifs."

Again with respect to the ore-distribution of Cornwall, Reid and Flett§ have stated: "Tin and copper mining in Cornwall

* *Loc. cit.*

† Skertchly, S. B. J., "On the Geology of the Country round Stanthorpe and Warwick, South Queensland, with especial Reference to the Tin and Gold Fields and the Silver Deposits." Published by Queensland Geological Survey. 1898.

‡ *Loc. cit.*

§ Reid, C., and Flett, J. S., "The Geology of the Land's End District." Memoir Geol. Surv. England and Wales, 1907.

has been carried on mainly near the margin of the granite where that rock is in contact with altered slate or greenstone. The distribution of the ores is, however, extremely partial, for the margin for long distances yields nothing of value, whilst other parts are exceptionally rich. So irregular is the distribution of the lodes, as laid down on the map, that at first sight it does not seem necessarily to indicate any close connection with the granitic intrusions, for many of the lodes are far distant from any granite mass seen at the surface. When, however, we take into account the contour of the buried granite masses and their proximity to the surface, as suggested by the extent of the metamorphism, and also the probable nearness in certain places of the slaty dome which once covered what is now bare granite, the close relation of the lodes to the intrusion of the granite becomes more evident."

The deposits at Altenberg and at Zinnwald exhibit the same characteristic distribution. Here the tin-bearing rock is a granite intrusive into granite-porphyry at Altenberg, and into "Teplitz" quartz-porphyry at Zinnwald. The tin occurs in both places as stockwork, the impregnated granite receiving the name of "Zwitter" rock. The granite itself, as far as can be judged by handspecimens, is very similar to a fine-grained tin-bearing granite containing microcline, to the south of Tingha.

Whilst it is true that most of the tin-deposits in this part of New England occur at or near the margin of the intrusive "Acid Granite," the converse, that all such contacts are tin-bearing, cannot be said to be true. As in Cornwall much, if not most, of the contact-zone is barren or unproductive.

The System of Fractures.

For a genetic investigation of ore-deposits, few factors are more important than the relations of the ore-bodies to the systems of fracture of the country. The importance of these relations was early recognised by Elie de Beaumont, in his work on the Fracture-Systems of Europe. An investigation of the fissure-systems of Cornwall, by Moissenet*, has proved of much value in the economic working of the mines.

It is proposed to devote some attention to the fracture-systems of the Elsmore-Tingha area. These may be considered with relation to dykes, faults, ore-filled fractures, and joints. At Elsmore an area about one-quarter of a mile square has been bared by surface-sluicing, and the tin-bearing reefs lie exposed on the surface in a most exceptionally favourable manner for studying their distribution. A series of sections was made in a direction nearly perpendicular to the previously ascertained general bearing of the reefs, and, from the data collected, the accompanying plan (text-fig. 2) has been constructed. The point marked A is 850 yards distant, in a direction S. 4° E., from the south-west corner of Portion 246, Parish of Anderson, County of Gough. The general north-easterly trend of the veins is at at once apparent.

From the tabulated list given (Table i., p. 757), which includes all the veins shown on the plan, it may be seen that rather more than 97 per cent. of the reefs lie within that third portion of the possible azimuths lying between N. 5° W., and N. 55° E. This tabulated list has been arranged to show the tendency of the reefs to cluster round certain directions. The two most prominent directions are N. 25° E., and N. 39·4° E., the latter being most strongly developed. As will be seen from the plan, these different systems of fracture often intersect. The system bearing 0° has some important fractures, and the systems bearing 16·5°, 51·8°, 45° and 53·2° east of north are all well developed.

Though many of the reefs intersect, it is quite common for one reef to terminate where it junctions with another. This abrupt termination of one fracture on another is very characteristic of fissures produced by torsion. Daubrée† and Becker‡ have

* Moissenet, Prof. L., "Observations on the Rich Parts of the Lodes of Cornwall." Translated by J. H. Collins, 1877.

† Daubrée, A., Etudes synthét. de Géologie expérimentale, 1879.

‡ Becker, G. F., "The Torsional Theory of Joints." Trans. Am. Inst. Min. Eng. xxiv., 1894.

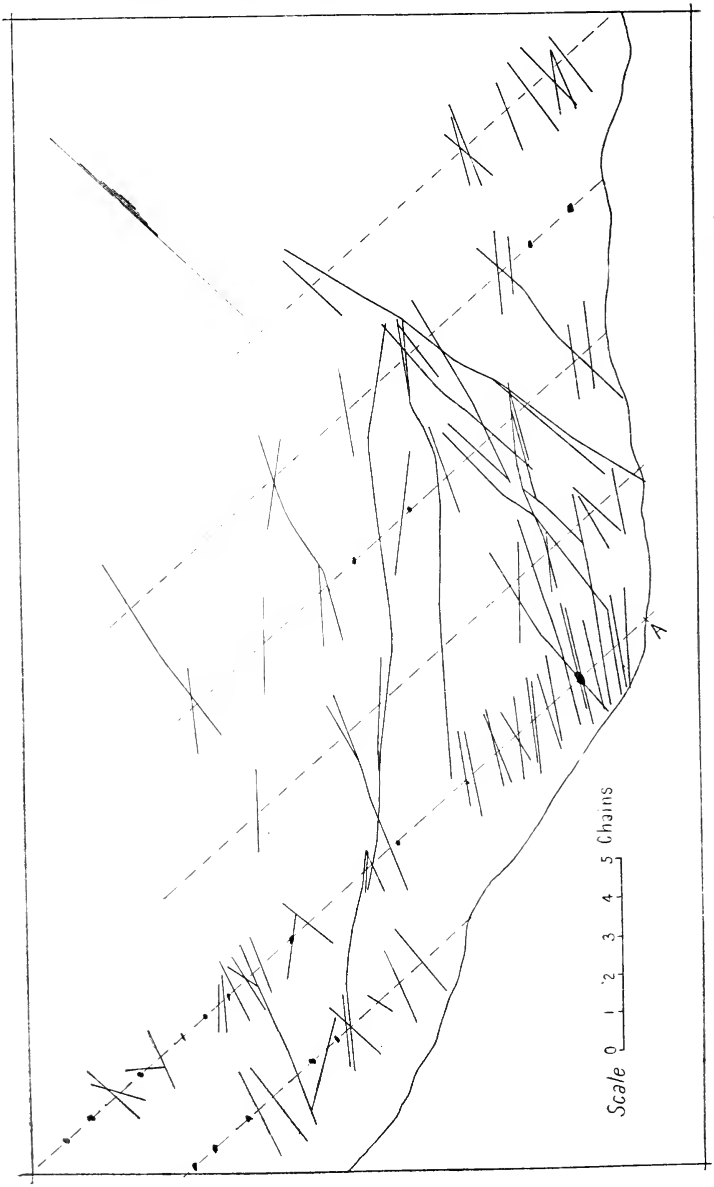

Fig. 2.—Plan showing trend and disposition of the reefs on Elsmore Hill.

experimentally established this result by torsion-experiments upon glass rods. They have also proved that the planes of fracture make angles of about 45° with the axis of torsion. In extreme cases, where great deformation took place before rupture was effected, the planes of fracture made angles as large as 60° with the axis of torsion. Daubrée has further shown that simple pressure on a body of a somewhat plastic nature, comparable to a rock-mass, gives rise to fracture-planes making 45° with the line of pressure.

As, then, in the area considered, the main fracture-system is about N. 39° E., the direction of pressure or axis of torsion must have been along a line bearing about N. 84° E.

In a body which is neither uniform, nor capable of great deformation before rupture, fractures may occur parallel to the direction of pressure. Near the north-west corner of Portion 214, Parish of Cope's Creek, County of Hardinge, an intrusion of the "Acid Granite" into the slates has been intersected by a series of faults. As the granite is the intruding body, and the slate the resisting one, we may assume that the slate has remained stationary, and that the granite has moved. This gives the direction of the thrust on the granite. The intrusion is that previously referred to in text-fig.1.

The creek has removed the soil, and the section is beautifully exposed. The intrusion took place as a long, narrow, approximately rectangular tongue, narrowest where it joins the granite-mass. Here it is only 9 inches in width, whereas at its extremity remote from the granite, it attains a width of 2 feet. This end abuts rather sharply against the slate, and has probably been faulted. Any continuation that may exist to the south is covered by alluvial. The direction of the intrusive tongue is S. 20° E., while a series of faults varying from N. 60° E., to N. 80° E. have thrown the tongue to the west. This is approximately the direction(84°) deduced from the axis of pressure or torsion which has acted on the Elsmore mass.

It is noteworthy that the main direction of fracture(N.39·4°E.) observed for the Elsmore granite-mass, corresponds very closely with that observed by Professor David for the Emmaville District. The mean of fifty-four lodes was a bearing of N. 39° 15′ E., and the average bearing for the richest lodes was N. 35° E. From the data in Professor David's book, I have tabulated a list (Table v.) of the bearings of the veins at Emmaville. A comparison of this table with that of the Elsmore veins, shows a striking resemblance. It would seem that the same system of forces was common to both areas. Even considerably to the north of Emmaville the fracture-system preserves its direction. Speaking of the disposition of the veins at Stanthorpe, as compared with those at Emmaville, Mr. Skertchley* observes:—"Hundreds of similar cases occur in the district. . . . . Their direction is always within a few degrees of north-east and south-west."

It is reasonable to suppose, and the assumption is based upon experience in the area here considered, that mining-towns have grown up upon those portions of the field where the ore-deposits are most abundant. If a line be drawn from Stanthorpe to Tingha, it is found to pass about 4 miles west of Emmaville, and midway between Elsmore and Newstead. Thus this line, which is about 100 miles in length, passes through the middle of each tin-mining centre. The bearing of this line is about 28° east of north. Thus it is evident that the general trend of the tin-bearing country approximates closely with its system of fractures. That there is very probably a genetic relation between these two directions, is indicated by the fact that the same close correspondence has been observed in the tin-deposits of Cornwall. With regard to these Cornish lodes, Moissenet* has written:—"Of 292 lodes registered by Mr. Henwood, the angle of 40° contained between E.W. and E. 40° N., includes 177, *i.e.*, 60 p.c. are contained in a range of 22 per cent. of the circle. . . . . The E.N.E. direction which generally prevails for the lodes is also that of the great metalliferous zone distinguished by Capt. Chas. Thomas, who remarked that the profitable mines were all

* *Loc. cit.*

included in a zone about 12 miles wide, extending from the Land's End to Exeter, a distance of about 108 miles in an E.W. (mag.) direction."

Mr. Skertchley has observed the same relation at the Queensland end of the New South Wales tin-belt. He states—"The tin-belt at Stanthorpe has no relation to the present ranges; it is neither parallel with the Herries nor the Dividing Range, and indeed the ranges struck me as being axes of denudation rather than of upheaval. The tin-belt is quite independent of them,

Table i.—Bearing of Reefs and Joints at Elsmore.

Number of Reefs..	1	14	4	10	19	14	27	10	10	2
				14						
	-10	-5	9	15	21	29	36	43	50	59
		-5	10	15	22	30	36	44	51	62
		-5	11	16	22	30	36	44	52	
		-2	11	16	23	30	37	44	53	
		-1		17	23	31	37	44	53	
		0		17	24	31	37	45	54	
		0		18	24	32	38	45	54	
		0		18	24	32	38	46	55	
		0		19	24	32	38	47	55	
		1			26	33	38	48	55	
		3			26	33	39			
		3			26	34	39			
		5			26	34	39			
		6			26	34	40			
					26		40			
					27		40			
					28		40			
					28		41			
					28		41			
							41			
							41			
							42			
							42			
							42			
							42			
							42			
							42			
Average Bearing...	-10°	0°	10·2°	16·5°	25°	31·8°	39·4°	45°	53·2°	60·5°

and is in direct relation to the stress-axis which induces the singularly persistent north-east and south-west joints and cleavages described in the chapter on granite. These stresses probably took place after the solidification of the granite."

The rather scanty observations made by me on the bearings of the dykes, lodes, and joints in the Oakey Creek granite(Table ii.)

TABLE ii.—BEARINGS OF DYKES IN THE OAKEY CREEK GRANITE.

0	13												
	20		35			55	65					105	

TABLE iii.—BEARINGS OF REEFS AND JOINTS IN THE MAIN ACID GRANITE AREA.

−4	15	23	30			55		72		98			158
0	17	25	32										160
0			35										
5													
5													

TABLE iv.—BEARINGS OF REEFS AND JOINTS IN THE TINGHA GRANITE.

−5	20	25			43	50	65	72	80	96	106	125	155
		25			48	53	65	72	84	98	107	132	157
						55	65	74	85	98	111	133	158
						55	65	78	88	100	111		165
						56	66		88	103			
						57			88	103			
						58			88				
						59			90				
									90				
									91				
									92				
									94				

and in the "Acid Granite" area (Table iii.), indicate that the fracture-systems in these areas are also related to those of the Tingha-Stanthorpe belt. The observations made on the lodes and joints in the "Tingha Granite" (Table iv.) show that, though the Elsmore system of fractures is represented, yet the main lines of weakness approximate to east and west rather than to north-east. As this east and west system is almost absent from the "Acid Granite" belt, it is probable that the Tingha system was earlier than the "Acid Granite" system, and may have been contemporaneous with the intrusion of the latter granite.

TABLE V.—BEARINGS OF EMMAVILLE LODES AND JOINTS.

	3	10	26	30	36	43	50	63	70	80	100	110	118
		15	26	30	37	43	50	65	70	80	105	110	120
		15	26	30	38	43	50	65	75	85		112	
		20	26	30	38	43	50	65	75	87		114	
		20	28	31	38	44	50	65	75	91			
		20	28	32	38		52		77				
		20	28	34	38	47	53	66					
			28	35	39		53	67					
				35	40		55	67					
				35	40		55	68					
				35	40		56	69					
					40		58						
					40		58						
					40								
					41								
					42								
					42								
					42								
					42								
Average Bearings...	3°	17°	27°	32·5°	39·6°	44°	53·1°	66°	73·7°	84·6°	111·5°		119°

N.B.—The bearings in the tables are all measured clockwise from the north azimuth, which is taken as 0° or 360°.

Having now discussed the distribution of the lodes, and their relations to the systems of fracture, the next important consideration is the nature of the ore-deposits.

Nature of the Ore-Deposits.

It is not the purpose of this paper to discuss in any detail the genesis of the ore-deposits, but rather to lay the foundation for such a discussion by a faithful record of their field-occurrence. It would be premature to attempt any such discussion without chemical and microscopical investigation. It is my desire to undertake this important phase of the work after having examined the deposits at Emmaville.

The question arises whether a classification should be made upon a morphological basis, or upon the nature of the vein-material. The usual method is the former, in which a classification is made into fissures, impregnations, stockworks, bedded deposits, etc. As, however, the form of an ore-deposit may have little to do with its genesis, the latter method is considered preferable for this paper.

The deposits may be grouped for purposes of description into eleven classes. Several of the classes merge into one another, and, indeed, the same reef may at different places fall into two or even more classes. Nevertheless, each class has its own special characteristics, and it is considered better at present to make the provisional classification rather more detailed than a final one may need to be.

The following is the proposed provisional classification :—

Class i.—Quartz-quartzose veins.
Class ii.—Quartzose.
Class iii.—Greisen.
Class iv.—Quartz-greisen.
Class v.—Quartz.
Class vi.—Quartz-felspar.
Class vii.—Chlorite-deposits.
Class viii.—Arsenical lodes.
Class ix.—Pipe-deposits.
Class x.—Cassiterite-veins in slate.
Class xi.—Stannite deposits.

Class i.—*Quartz-quartzose Veins.*

This class is most abundantly developed at Elsmore, where, indeed, it is the type-vein. The distribution of these veins has already been referred to, and may be seen at a glance from text-fig.2.

The individual veins are seldom of any great length or width, few being traceable continuously for as much as 10 chains. As a rule, they either terminate by thinning out rather abruptly, or by abutting on to a similar vein.

The average width, as calculated from 105 determinations, is 10·5 inches. The greatest width is 3 feet, and the smallest veins observed were 1 inch in thickness. About 75 per cent. of the veins are between 6 and 18 inches in width. A number of expanded masses of reef-material, of a circular or oval shape, are of frequent occurrence. These are to be found chiefly at the intersection of two reefs, but also occur as bulges on the line of reef, or as isolated patches. These "blows," as they are called, are represented in text-fig.2 as black patches. This type of reef is not limited to, or excluded from, any of the fracture-systems represented at Elsmore, though the largest veins conform mostly to the system N.43°E. It cannot be said that any of the reefs show great uniformity,—rather the contrary. Most veins are from 2-3 chains in length. As no shafts have been sunk on this area, the reefs are not exposed vertically, save in a few shallow trenches. In these the reefs appear to be vertical. In only three cases were dips noticed, and of these one dipped E.43°S. at 63°, another E.41°S. at 61°, and the third E.26°S. at 53°.

The country-rock is a coarsely crystalline granite, which is so decomposed at Elsmore that it is impossible to obtain a hand-specimen anywhere from the area shown in text-fig.2. A few hundred yards to the east of this area, fresh granite may be obtained, and is typically the coarse "Acid Granite" previously described.

None of the reefs have been systematically worked, only the surface-shoots having been mined. There is probably no single reef which would pay for working, but, on the eastern slope of Elsmore Hill, the reefs are so close together that the whole might be worked by an open cut. The exact tin-content of the reefs could only be determined by a very large bulk-sample.

The reefs appear very similar to those occurring both in the Stanthorpe district to the north, and at Mount Rex in Tasmania to the south. Indeed, descriptions of the occurrences in these districts, coupled with the examination of hand-specimens, render it abundantly clear that the same processes have been active in the vein-formations of all three areas. Though well defined as reefs to the casual eye (see Plate lxi., fig.1), a close examination shows that they pass over almost imperceptibly from vein-stuff into the soft decomposed granite. A type-section through one of these veins is given in text-fig.9. The centre of the vein is composed of translucent quartz, as opposed to milk-white, opaque quartz on the one hand, and clear transparent quartz on the other hand. This central quartz passes rather abruptly, yet without discontinuity in composition, into a quartzose vein-stuff. This latter is highly siliceous, and is composed mainly of granular quartz, the grains being from 1-2 mm. in diameter. Intimately distributed through this matrix of quartz, and abundantly present, is a variety of mica. This is light to dull green in colour on a fresh fracture, but weathers reddish-brown on exposure. These mica-flakes are quite small, the largest attaining a diameter of about 2 mm. Inter-crystal cavities are quite abundant, and these are frequently filled with limonite (see Plate lxi., fig.2). The central quartz usually constitutes of about one-fifth, but occasionally occupies as much as one-half of the entire width of the vein. Vughs are common in both the central quartz and quartzose, and in some of the larger veins are as much as a foot in diameter. They are typically lined with crystallised quartz, the long axes of the crystals being normal to the walls of the cavities. Mica and hydrous iron-oxides are also common fillings of these vughs.

The central quartz band of the veins usually exhibits well developed comb-structure, and cassiterite may be found crystallised between the quartz-crystals. The cassiterite was invariably found near the centre of the veins, either irregularly distributed through the central quartz, or, as is more frequently the case, forming a casing on either side of it. Cassiterite also occurs in vughs. It is usually crystallised, the average length of the crystals being about one-quarter of an inch. In many instances crystallised quartz may be seen abutting on to crystallised cassiterite, the latter preserving its normal form, and thus indicating its prior crystallisation. The cassiterite is dark brown to black in colour, and assays from 73 to 76 per cent. metallic tin, after being cleaned by the "Willoughby." Fractured crystals frequently show a well marked series of layers parallel to the crystal-faces.

The minerals occurring in this type of vein are quartz, mica, wolfram, bismuth, molybdenite, and fluorite.

The *quartz* occurs both massive and crystallised, and in the centre of the reef. The crystallised quartz occurs most frequently lining the vughs, and projecting inwards. The individual crystals may be as much as 2 inches in diameter, and several inches long. Occasionally there is a peculiar development of very flat crystals, the distance between one pair of prism-faces being less than $\frac{1}{4}$ of the width of the crystal. Double-ended quartz-crystals are also very common. The crystallised quartz may be clear and colourless, translucent or smoky. Some of the smoky quartz-crystals contain so much impurity that they are quite opaque when only about $\frac{1}{4}$ of an inch in thickness. Occasionally both clear and smoky quartz-crystals are to be found invested in a sheath of milk-white, opaque quartz, the thickness of which is about $\frac{1}{10}$ the width of the crystal.

The *mica* occurring in these veins has already been remarked on. It cannot be certainly named until an analysis has been made. As, however, the type of vein is similar to that previously described* from near the Leviathan Mine, it is probable that the mica is allied to the paragonite group.

Wolframite is found both crystallised and massive. Its distribution in the veins is similar to that of the cassiterite, and both minerals may be obtained in the same hand-specimen. Platy crystals are common, and a yellow ochreous mineral has been observed between two diverging plates. The wolframite is not abundant, for very little is obtained when cleaning the tin for market. Its total weight is probably less than one per cent. of the tin present at Elsmore.

Topaz and tourmaline have not been observed, and cannot be present in any quantity.

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* Cotton, Leo A., "Metasomatic Processes in a Cassiterite Vein from New England." These Proceedings, 190[?], p.220.

Molybdenite occurs rather less abundantly than wolframite, and is to be found in small hexagonal flakes throughout the more siliceous parts of the veins.

Felspar is notably absent, except in close proximity to the edges of the vein, and even here it can only be recognised microscopically.

Beryl was reported by Mr. Ulrich* who states the following: "I discovered lumps of a ferruginous clayey substance full of thin light green and yellow hexagonal prisms of beryl associated with larger quartz-crystals. I also found beryl on crystallised cassiterite specimens in fragile prisms generally not thicker than a stout pin and up to an inch in length interlaced between the tin-ore crystals." Unfortunately, although I found abundant vughs containing "a ferruginous clayey substance," I did not see anything to correspond with Mr. Ulrich's discovery.

Fluorite occurs very sparingly, and has only been recognised microscopically.

Both *native bismuth* and *bismite* are rather sparingly present in the veins.

Class ii.—*Quartzose.*

This class is merely an extreme case of the previous one, in which the central quartz is not developed. The general remarks with regard to the size and continuity of the veins of Class i., also apply to this type of vein. A good example of this class is a reef situated on the south bank of the Macintyre River, near Elsmore. This was opened as a molybdenite mine. The molybdenite occurs rather plentifully throughout the reef, in small hexagonal flakes, the largest being rather smaller than a shilling. The quartz is translucent, and contains a small amount of a greenish-grey scaly mica, similar to that previously mentioned. Vughs occur plentifully, and these are frequently filled with mica and hydrous oxides of iron. The reef is about 18 inches wide, is vertical, and has been sunk on for about 12 feet.

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* *Loc. cit.*

Class iii.—*Greisen.*

These deposits occur typically in bunches, though irregular reefs do occur. The rock is highly micaceous, quite a subordinate amount of quartz being present. The mica is of the nature of that mentioned in Class i.

These greisen bunches are often exceedingly rich in cassiterite, as much as 15cwt. of that mineral to the ton having been obtained. The cassiterite is always crystallised, and of a black colour. The masses or reefs pass over, without any abrupt change in composition, into the surrounding granite. The reefs are usually less than one foot in width, and are much more irregular than those of Class i. The cassiterite may be either coarse (rather larger than a pea) or very fine. I have seen samples carrying more than 10 per cent. of tin, in which none was visible to the naked eye. It must not be supposed, however, that the greisen is always tin-bearing, for much is quite barren. Unlike the greisen of the Altenberg and Zinnwald districts, the Elsmore greisen contains no topaz.

The rock occurs abundantly on the eastern slope of Elsmore Hill, where large masses, 6 to 10 feet in diameter, may be seen. So much of the hill is greisenised, indeed, that it is difficult to obtain from this locality a specimen of unaltered granite. Near the Newstead Shaft another development containing very rich tin occurs, but the greisen occurs in a reef of small size in hard acid granite. It is commonly associated with the quartz-quartzose type of vein, occurring in small bunches at the side of the lode.

Greisen also occurs, but not abundantly, at the Leviathan Mine. It is strikingly absent from the lodes in and near the Tingha Granite.

Class iv.—*Quartz-Greisen.*

A few veins have been observed, consisting chiefly of greisen but containing a central vein of quartz. This quartz is usually of the milk-white, opaque variety, and has been observed to carry crystal-tin. The quartz and greisen are separated by a small band of the quartzose rock characteristic of Class i. There is typically about 1 to 2 inches central quartz, rather less than an inch of quartzose, and from 8-12 inches of greisen in these veins. They occur only, as far as I know, on the western slope of Elsmore Hill, and the largest vein is about 35 yards in length and 10 inches in width.

Class v.—*Quartz-Veins.*

Two kinds of veins may be included in this class—(a) Smoky Quartz-Veins; (b) Veins of Translucent Quartz.

(*a*) The veins of smoky quartz are always small, varying from a mere thread up to 2 or 3 inches in width. The quartz is fine-grained and granular, and contains small cavities filled with earthy iron-oxides. The veins pass gradually from almost pure quartz into the country-rock. They have been observed only in two localities—near the Leviathan Mine, and about 2 miles east of the Bischoff Lode. In both cases the country-rock is the Acid Granite.

(*b*) Veins of this kind are characteristic of the Tingha area, more especially. The reefs are never of large size, the largest averaging less than 2 feet in width. For the most part the so-called lodes are composed of more or less parallel bands of quartz, which vary from a small fraction of an inch up to 5 or 6 inches in width. They appear to be no more uniform or continuous than the quartz-quartzose reefs at Elsmore.

A good example of this type of vein is the Butchart Lode. This lode occurs in the "Acid Granite," near its junction to both slate and Tingha Granite. At its south-western extremity, which bears N.50°E., it has been trenched for about 150 feet in length. The lode lies on the slope of a hill facing south-west, and the depth of the trench varies from zero to about 25 feet. There is little to be seen in this part of the workings, as the ore has been quite removed. The lode was opened again a score or two of yards to the north-east. Here again, the ore was taken out of an open cut, which bears N.74°E., extends for over 100 feet in length, and is from 3 to 4 feet wide. The so-called lode consists of a number of small quartz-veins, more or less parallel to one another. These vary in thickness, from a mere crack up to 2 inches in width. Most of the veins are about $\frac{1}{4}$ of an inch wide, but there is a main vein, about 2 inches thick, which has determined the course of the workings. The small quartz-veins are very irregular, and pinch out abruptly. In constitution they vary from solid quartz to solid cassiterite. Where these veins are oblique to the direction of the trench, they may be seen prominently marking the sides, but are evidently too far-spaced and patchy for economic working. Most of the veins are sharply marked off from the granite, which is hard and undecomposed. No trace of greisen is present.

A prominent feature of this deposit is the number of iron-stained bands accompanying many of the veins. The veins are evidently of the nature of impregnations from the vein-fissure, at some stage in its formation. They occur sometimes on one side only, and sometimes on both sides of the quartz. The zone of iron-stained granite is usually wider than the quartz-vein. There are three phases of occurrence—

(i.) Iron-stained bands with neither quartz nor cassiterite.

(ii.) Iron-stained bands with central veins of quartz. These often contain cassiterite at the junction of the quartz and iron-stained granite.

(iii.) Iron-stained bands with central veins of cassiterite.

A section of the lode, as seen at the end of the open cut, is given in text-fig.3.

Class vi.—*Quartz-Felspar.*

This type is economically the most important, because not only are these deposits usually the richest, but are also the most easily mined. The association of the quartz and felspar is as follows:—

(i.) Veins of highly felspathic rock traversed by veins of translucent quartz.

(ii.) Quartz and felspar intimately intergrown.

(i.) A typical example of the first, is a reef about $\frac{1}{4}$ of a mile to the east of Sutherland's Water, about a mile from its junction with Cope's Creek. Here the lode has been sunk on, and some good ore has been taken out. The lode runs east and west. The

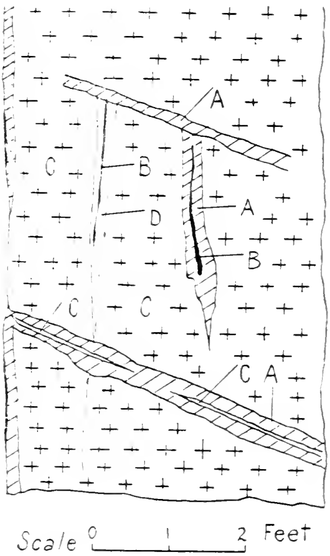

Fig. 3.

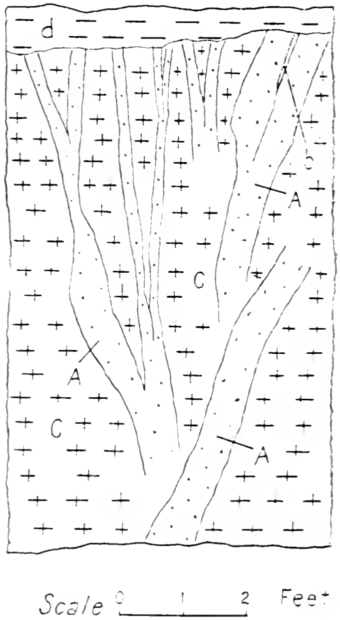

Fig. 4.

Fig. 3.—Section across the Butchart Lode. A, Brown iron-stained granite-bands; B, Cassiterite; C, "Acid granite"; D, Quartz.

Fig. 4.—Section across a quartz-felspar lode, near Sutherland's Water. A, Felspathic lode-material carrying cassiterite and a little quartz; b, Quartz-vein; C, "Acid granite."

eastern side of the shaft shows an irregular venation (text-fig. 4). The felspathic rock contains a little quartz throughout, and is intersected by small veins of translucent quartz, which often contain cassiterite. More commonly, however, the cassiterite occurs on either side of the quartz-vein, and separates it from the felspathic rock. The country-rock is "Acid Granite," and this is invariably very soft and decomposed in the neighbourhood of the lode, though hard and fresh a few yards distant. The presence of this decomposition-product in connection with the lodes is, I think, very significant, and of genetic importance. The lodes of Cornwall frequently present the same characteristic. The veins of quartz intersecting the felspathic lode-material often pass into felspar or cassiterite, while still preserving the same width. Text-fig.5 illustrates this.

One curious case was observed in which the cassiterite arranged itself in two parallel planes, each entirely in the felspathic lode-

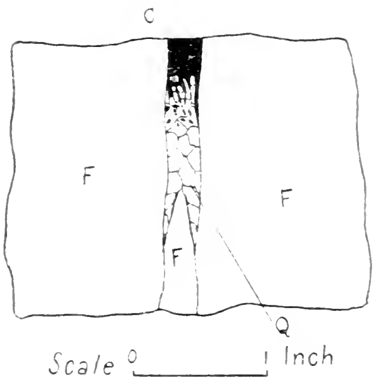

Fig. 5.

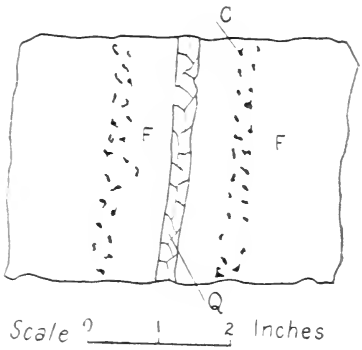

Fig. 6.

Fig. 5.—Portion of quartz-felspar lode, showing how the quartz-vein may pass into cassiterite or the felspar of the lode. Q, Quartz; C, Cassiterite; F, Felspar.

Fig. 6.—Section of quartz-felspar lode, showing peculiar disposition of cassiterite. Q, Vein-quartz; C, Cassiterite; F, Quartz-felspar lode-material.

material, and about an inch distant from the central seam of quartz(see text-fig.6).

(ii.) A number of lodes occur, which consist of a very intimate quartz-felspar mixture, the latter mineral predominating. In these, cassiterite, where it does occur, is distributed with a fair degree of uniformity. No bands or seams are to be seen, but it occurs as a constituent of the rock (see Plate lxii., fig.2). These lodes are frequently very soft and, as in the first group, the country-rock is soft and decomposed. In any particular lode much is quite barren, the cassiterite occurring in rich patches.

The quartz is well crystallised, and double-ended crystals are common. It is clear and of the glassy type. Cassiterite is sometimes included in crystals of quartz.

One occurrence deserves special mention. This is known as Hutchinson's Felspar-Lode, and is situated about 3 miles, south by east, from Tingha. Here large masses of crystallised felspar were found associated with very coarsely crystallised quartz. Felspar-crystals, several inches in length and with very perfect crystal-form, are still to be obtained. Masses of smaller crystals of quartz and felspar, intimately intergrown, also occur. (Plate lxii., fig.3).

Class vii.—*Chlorite-Deposits.*

These deposits are of the nature of impregnations, and do not appear to be associated with fissures. They are rather rare in the area under consideration, though similar deposits seem to be very abundant in Queensland, and Cornwall. At Stannifer an interesting deposit was worked by Mr. Stormer. This consists of an ill-defined, mineralised area surrounded by hard "Acid Granite." It does not present any of the features of an ordinary lode, and is limited in extent to about 50 square yards. The gangue-minerals are chlorite, hydrous iron-oxides, quartz and felspar. Handspecimens may be obtained, showing the passage from chlorite vein-stuff into the granite. In these the vein-stuff is seen to be chiefly chlorite and felspar, while the granite is almost wholly quartz and felspar. The deposit, then, appears to be an impregnation in which quartz has been replaced by chlorite.

About half a mile to the west of this deposit, lies the so-called Kelly's Reef. This was found in sinking for alluvial, at a depth of about 6 feet. The deposit was followed downward for about 25 feet, and appears to have been about 6 or 8 feet in diameter. The dip is about 40° in a direction S.35°E. The shape could not be accurately determined, but it appears to have been roughly cylindrical. Part of the vein-stuff still remains in the floor of the excavation. The main lode-stuff consisted of chlorite and felspar, and was separated from the country-rock by a zone of hydrous iron-oxide. The country-rock is the "Acid Granite," and is quite soft and decomposed in the neighbourhood of the deposit. From the excavated material a specimen of granite, strongly impregnated with some iron and much arsenical pyrites, was found. Another interesting specimen was a piece of pegmatitic quartz and felspar, passing into a fine-grained chlorite-rock. Scheelite is also present in small quantity.

Text-fig.7 shows a section of the west wall of the excavation, and indicates the relation of the lode-stuff to the country-rock.

A similar occurrence is that of the "Strand Mine," about 2 miles N.E. from Howell. The deposit, like those previously mentioned, does not appear to have any linear extension, and hence cannot be called a lode. A great amount of lode-material

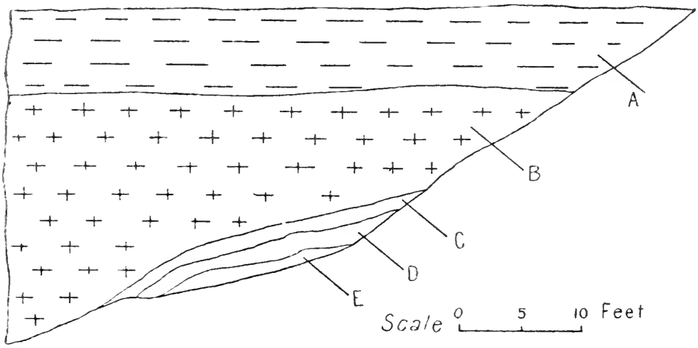

Fig. 7.—Kelly's Reef at Stannifer. A, Alluvial; B, Soft decomposed "Acid Granite"; C, Zone of yellow iron-oxide; D, Zone of mixed ironstone, chlorite, and felspar; E, Chlorite and felspar of lode-material.

has been excavated from a shaft sunk on the deposit. The lode-stuff consists chiefly of chlorite. There is more quartz associated with the deposit than at Stormer's and Kelly's reefs. This quartz is clear and crystalline, and occurs in bunches and veins showing comb-structure. These veins and bunches of quartz are almost invariably bordered by a zone of pink felspar. This is illustrated by Plate lxii., fig. 1. Scattered through the quartz are small bunches of galena, which have not been observed in either the felspar or chlorite. Vughs in the chlorite lined with quartz-crystals are of common occurrence. The country-rock is the "Acid Granite," and a regular transition can be made out between this and the chlorite lode-material.

A rather different deposit of some interest is that known as Cox's Reef, situated about half a mile west of Murray's Water. A number of joint-planes in the granite have been impregnated with chlorite, and the country-rock, the Tingha Granite, has been altered for a few inches on each side of the vein. The veins are small (from one-quarter to half an inch wide), and consist of two groups, one bearing N.66°E., and the other E.6°S. In this occurrence the chlorite is associated with greenish glassy quartz-veins, which abut sharply against a zone of felspar-rock contain-

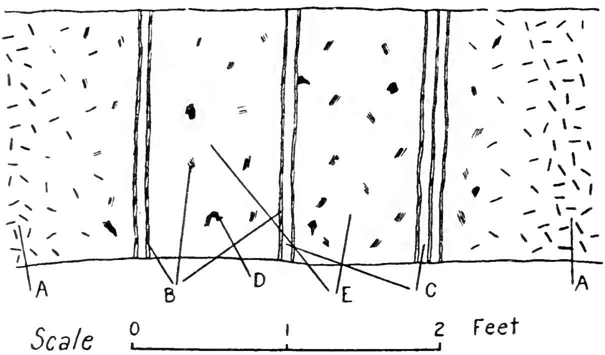

Fig. 8.—Section across Cox's Reef, near Murray's Water. A, The Tingha Granite; B, Chlorite in patches and veins; C, Quartz; D, Cassiterite; E, Felspar, constituting main bulk of lode-material.

ing chlorite and cassiterite. There also occur minute crystals of a green colour, prismatic in habit, which are probably beryl. The felspar-zone passes gradually over, by increases of quartz and a different development of the felspar, into the normal granite The total width of the lode-stuff is about 2 feet, and it is traversed by several of these chlorit-eveins. (Text-fig. 8).

Class viii.—*Arsenical Lodes.*

These lodes are of comparatively rare occurrence in this area. The first observed has rather a peculiar association, and will, therefore, be described.

In one of the typical quartz-quartzose reefs at Elsmore, a band of arsenical pyrites, about 3 inches wide, was found occupying the place of the typical central quartz-rib for about 20 feet along the vein. For a sketch-plan of this, see text-fig. 9. It will be noticed that the arsenical lode commences at the junction of two reefs of the quartz-quartzose type. At this junction is a mass

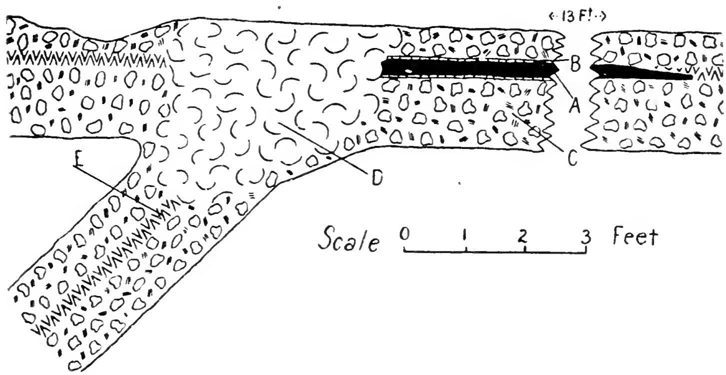

Fig. 9.—Junction of a typical quartz-quartzose vein with a similar one, rendered unique by the presence of arseno-pyrite. *Loc.* Elsmore. A, Band of arseno-pyrite; B, Bands of ironstone; C, Quartzose zone, consisting of granular quartz and mica; D, Massive ironstone; E, Comb-quartz, forming central band of lode.

of ironstone, from the southern margin of which the arsenical vein emerges. This arsenical band pinches out gradually, and the normal quartz-filling takes its place. On examination, the vein was seen to consist largely of mispickel, some of which had oxidised to arseniate of iron. The vein is cased, on each side, by a band of iron-oxide, about $\frac{1}{8}$ of an inch thick. It contains abundant fragments of quartz, and also double-ended quartz-crystals, such as are common in the central quartz of the quartz-quartzose veins.

About half a mile further east, and on the eastern side of a small gully flowing into the Macintyre, two arsenical lodes occur. These consist of mispickel, finely impregnated through a siliceous base. The cassiterite-content is small.

Several similar reefs occur at Stannifer, and mispickel is also present at the Leviathan Mine. I do not know of any such occurrence in the "Tingha Granite."

Class ix.—*Pipe-Deposits.*

These deposits are of a most interesting and unique type. Only a few occur in the area under consideration. The general features of these deposits are more or less circular or oval cross-sections, and great irregularity in amount and direction of dip. They are generally of small size, varying from 2 to 6 feet in diameter. Unfortunately, at the time of my visit, none of these pipes were being worked, and water had accumulated in the excavations of previous workings. Hence it was possible to examine only the sides of the pipes, and some of the material lying on the surface of the ground from the central portion.

Though the pipes have been abandoned when the cassiterite-values became too small, there is no evidence to show that the structures are not continuous in depth; on the contrary, the pipes, where abandoned, show every sign of permanence.

Smith's Pipe is situated in the Tingha Granite, a few hundred yards from its contact with the "Acid Granite." It is about three feet in diameter, and was followed down as a cylindrical deposit. The first eight feet from the surface was nearly vertical, after which it dipped steeply to the north, and continued in this direction to a depth of about 90 feet, at which depth it was abandoned. It is not safe to descend, so that all that can be seen now is, that the pipe occurs in solid Tingha Granite, apparently unconnected with any reef at the surface. Conditions are not favourable for observing whether any strongly marked joint-planes intersect the deposit. The central core of the pipe was composed of a highly felspathic material, and contained abundant cassiterite. The present walls of the pipe are soft and kaolinised. This change is connected with the genesis of the deposit, for the kaolinisation passes gradually from the centre outwards into solid undecomposed granite, a few feet distant.

A somewhat similar occurrence is known as *Hong Hay's Pipe*. This was examined by Mr. C. Saint-Smith and myself, and the following are our observations.

Though no work was being carried on at the time of our visit, we were able to descend for about 50 feet, and make a careful examination of the walls of the pipe. Though the central core, which was exceptionally rich in tin, had been removed, we were able to obtain samples of cassiterite from a number of places on the walls of the pipe. The pipe is oval in shape, being about 3 feet 6 inches in the long, and 2 feet 6 inches in the short diameter. It occurs in a hard fine-grained modification of the Acid Granite, which is here strongly jointed in two directions. The master-joints bear N.49°W., and the subsidiary ones N.55°E. None of these joints were altered by impregnations at a distance of three yards from the pipe. The pipe dips at 49° in the first 12 feet, in a direction S.35°W., and then at 35° for the next 40 feet of descent. It then takes a very steep dip in the same direction. The central part of the pipe is reported to have been highly felspathic, soft and easily mined. The present walls of the pipe consist of a white, fine-grained, friable casing of a felspathic nature, containing in places a good deal of cassiterite. At the end of the shallow dip there appeared, in the roof of the pipe, two oval holes which extended upwards for about three feet. One of these was about nine inches, and the other six inches in the longer diameter. Each possessed a smooth surface lined with the same friable felspathic casing aforementioned. About two feet to the west of these, a small vein of quartz, showing comb-structure, entered the pipe. There also occur, at intervals, in other parts of the pipe, veins of iron-stained material containing cassiterite, identical in character with those seen in the Butchart Lode.

About 50 yards distant, to the south-west, another pipe occurs. This was sunk on for a few feet, but no cassiterite was found. The pipe-material excavated has been left lying at the mouth of the shaft, and consists of a friable felspathic rock containing a good deal of quartz. This latter mineral is of the clear glassy type, and is crystallised in small prisms up to nearly an inch in length. The country-rock is the same as at Hong-Hay's Pipe.

These pipes are of a rather different nature from those described from the Transvaal, by Kynaston and Mellor.* These gentlemen have described a number of very interesting pipes, characterised by intense alteration of the granite in which they occur. In many of these pipes a characteristic zone of tourmaline borders the outer edge of the pipe, while the central portion consists chiefly of quartz and mica. It is possible that some of the Transvaal pipes, in which this tourmaline-ring is absent and the central filling is chiefly quartz and felspar, may be similar to those occurring at Tingha. These are regarded in the Transvaal as the simplest and least altered type of pipe-formation.

Class x.—*Cassiterite-Veins in Slate.*

Another type of deposit occurs in the slates, near the junction with the granite, about 3 miles south of Elsmore. Here the slate is intersected by minute veins, about 1 mm. in thickness, which consist of solid cassiterite. The mineral is sharply marked off from the slate, which does not appear to have suffered any change near the vein. These bands of cassiterite are too few and far apart to pay for economic working.

Class xi.—*Stannite-Deposits.*

Only one deposit of this nature is known; this occurs at the Conrad Stannite Mine, near Howell. The lode is a true fissure-deposit in granite, and is primarily a lead-silver ore-body. The stannite occurs as a minor constituent of the lode, and is associated with galena, zinc-blende, arseno-pyrite, and copper-pyrites.

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* Kynaston, H., and Mellor, E. T., "The Geology of the Waterburg Tin-Fields." Memoir No.4. Geological Survey of Transvaal, Department of Mines.

Any account of the tin-deposits of this district would be incomplete without some mention of the occurrence near Auburn Vale, where the Hillcliff and Leviathan Mines are situated.

The Hillcliff Mine has been opened up by several shafts on two reefs about 10 yards apart. The country-rock is a coarse "Acid Granite," similar to that at Howell. In one part, near the lode, the granite is found strongly impregnated with arsenopyrite. This mineral occurs as crystals, and appears as much an original constituent as the quartz or felspar of the granite. Manganese and iron-oxides are also present in the lodes. Here, also, apatite was found crystallised along one side of a quartz-felspar vein.

The Leviathan Mine is about one mile to the south-west of Hillcliff. It is of rather a complicated nature, and contains several of the proposed classes of veins. The country-rock is coarse "Acid Granite," similar to Hillcliff. Considerable work has been done at the mine, and several hundreds of tons of ore have been removed by open cut workings. Text-fig.10 represents a ground-plan

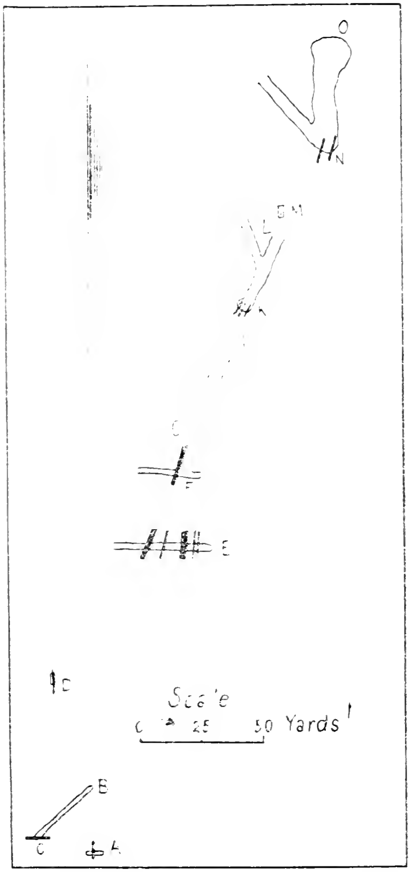

Fig. 10.—Plan of workings of Leviathan Mine. The lettering is referred to in the text.

of the workings. The lodes or impregnated bands run in a N.N.E. direction, and have been opened by a series of open cuts, and cross trenches. The southernmost of these (Fig.10,A) intersects a greisen-vein underlying slightly to the east. At B, a few small stringers are exposed. At C, a lode of silicified granite, about 4 feet wide and containing mispickel, is intersected by the open cut. At D, a shaft has been sunk on a lode similar to that at A. The lode bears north and south, and underlies at 70° to the east. At E, a trench 50 yards in length, 10 feet in depth, and 4 feet in width, has cross-cut several lodes. These appear to be impregnated bands in the granite. Part of the granite is soft and decomposed, with hard patches of silicified granite throughout.

From F to G there is an open cut, about 8 feet in width. This intersects bands of altered granite of a peculiar appearance. The alteration has taken place in horizontal layers, which are separated by soft decomposed granite. These layers dip to the south-west at about 15°. This type of impregnation is a common feature of some Cornish mines.

From G to I the open cut is 14 feet deep at the south end, and runs to zero at the north end. Bands of altered granite, containing cassiterite, have been removed. From this locality I obtained a fine specimen of apatite intergrown with plates of wolframite. Mispickel is also present, and its oxidised products have stained the surrounding granites a characteristic green colour.

K to L represents another open cut, of a similar nature. M is a prospecting shaft, now in course of development. This is down to a depth of 80 feet, and a drive has been put in at this level for a distance of 27 feet to the west. At a distance of 10 feet, a band of highly altered granite, constituting a lode, was met. This was driven through for 17 feet, where the normal granite was again appearing. The lode-material consists of quartz, mica, arseno-pyrite, and chlorite; and the central portion, for about two feet in width, carried crystallised cassiterite. The lode-material passes rapidly over into the "Acid Granite." Further to the north is another open cut, from N to O(text-fig.10). This is the largest excavation, and presents an interesting feature, in that there is here a considerable development of copper-carbonates. A parcel of rich tin-ore was obtained from C(text-fig.11). This occurred in a soft, iron-impregnated, sandy material lying close to a slickensided wall, which separated the lode from a soft and

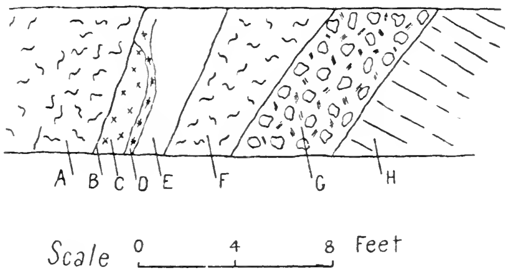

Fig. 11.—Section across Leviathan Lode. A and F, decomposed granite; B, slickensided wall of lode; C, Soft ironstone-band with cassiterite; D, Hard ironstone-band with less cassiterite; E, Dark siliceous rock, constituting lode; G, Lode of quartzose-type; H, Silicified granite, showing platy structure.

decomposed granite. G represents a lode similar to the quartzose type at Elsmore. H is a belt of silicified granite, in platy layers dipping to the south-west.

The occurrence of copper-ores at this mine is of interest and importance, in view of the fact that many of the lodes of Cornwall were originally worked for copper, and only made into tin at a depth.

Chapter iv.—Conclusion.

The foregoing is a description of the general geology of a portion of New England, with special reference to the tin-ore deposits of that district. The area represented on the accompanying map, lies within the rectangular block, at whose corners are situated the towns of Inverell, Bundarra, Glen Innes, and Guyra. It is mainly in the western portion of this block that the tin-deposits occur.

There are three geological units within the tin-field—(1) a series of slates and claystones; (2) a series of granites; (3) a series of basalts; while a fourth flanks its eastern side. The slates are Palæozoic, and are probably of Silurian age. The basalts are the youngest of the formations, and their age has been determined as Tertiary. The granites are intrusive into the Palæozoic slates, and their age has been provisionally stated as Permian.

There are two chief granite-types—(1) the "Acid Granite" of Mr. E. C. Andrews, and (2) an older and more basic rock which I have called the Tingha Granite.

The "Acid Granite" is chiefly a quartz-felspar rock. A little biotite is present in some phases; and in another phase tourmaline is fairly abundant. The Tingha Granite also has several phases, those at Oakey Creek and south of Tingha being the most important. The tin-ore deposits have been found always closely associated with the "Acid Granite," though post-dating the solidification of that rock. It is very common to find the ore-deposits close to the contact of this rock with the older Tingha Granite and the slates. Where the ore-deposits occur at a distance from such contacts, there is usually evidence to show that there has really been a contact at no great vertical distance, and that this has been removed by denudation.

On examining the fracture-systems of Elsmore, Emmaville, and Tingha, it was concluded that the force causing these was a thrust from the east, or a torsional stress having the axis of torsion approximately east and west. It was noted that the system of fractures corresponds closely with the general trend of the tin-bearing belt, both being best developed in a direction about N.E. by E.

The tin ore-deposits have been grouped into a number of classes. The chief of these are (*a*) the quartz-quartzose type; (*b*) the quartz-felspar type; (*c*) the pipes; and (*d*) the chlorite-deposits.

In conclusion, I should like to record here my indebtedness to the following gentlemen: to my brother, Mr. C. M. Cotton, who accompanied me during the greater part of the field-work, and rendered much assistance by his observations and suggestions; to

Mr. J. E. Carne, and Mr. C. Saint-Smith for very kind and valuable assistance throughout; to Mr. W. S. Dun, Professor T. W. E. David, and Dr. W. G. Woolnough, of the Sydney University, for practical help and sympathy in my work at the University; to Mr. Penberthy of Elsmore; to Mr. Stormer of Stannifer, and to many other miners whose kindness and cooperation have enabled me togather much of the material that is now presented in this publication.

EXPLANATION OF PLATES LIX.-LXIV.

Plate lix.

Fig.1.—The Macintyre River, south-east from Elsmore, showing bare granite-rock on the northern slope of the hill.

Fig.2.—The Tingha Granite, showing biotite and porphyritic felspars: two-thirds nat. size.

Plate lx.

Fig.1.—Cemented rock on Elsmore Hill, showing hard band with inclusions of reef-quartz overlying soft, uncemented rock of the same composition.

Fig.2.—The "Acid Granite," from near Elsmore: half nat. size.

Fig.3.—The "Acid Granite," from King's Gap: half nat. size.

Plate lxi.

Fig.1.—Elsmore Hill, showing reef running from pile of stones to observer.

Fig.2.—Specimen from quartz-quartzose reef at Elsmore, showing vughs lined with quartz-crystals; the black patches are cassiterite: half nat. size.

Plate lxii.

Fig.1.—Lode-material from Strand Mine, near Howell. Q, crystallised quartz; F, felspar surrounding quartz; C, chlorite: nat. size.

Fig.2.—Cassiterite in quartz-felspar lode-material: half nat. size.

Fig.3.—Quartz and felspar intimately intergrown, from Hutchinson's Felspar-Lode: half nat. size.

Plate lxiii.

i.—Section, from Elsmore to Kelly's Creek; represented by P-P on geological map. Formations represented as on geological map.

ii.—Section, from Oakey Creek to Wandsworth; represented by Q-Q on geological map. Formations represented as on geological map.

Plate lxiv.

Geological Map, illustrating the Palæozoic Geology of the Elsmore-Tingha Tin-field, New England District, N.S.W.

THE GENERAL GEOLOGY OF MARULAN AND TALLONG, N. S.W.

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(Plates lxv.-lxix.)

Contents.

The physiography of this area has already formed the subject of a paper by Mr. T. G. Taylor, B.Sc., B.E., and the author. In addition to the interesting problems it presents in river-development, the district is very remarkable for the variety of its rock-formations. Within a radius of about six miles, we have sediments of Ordovician, Silurian, Devonian(?), Permo-Carboniferous, and Triassic(?) ages. Intrusive rocks are represented by a great boss of grano-diorite intersected by numerous aplitic dykes, and passing into granite-porphyry, and quartz-porphyry at its margins. Extensive Tertiary basaltic flows occur in the eastern part of the area, and with them are associated plant-bearing tuffs and bauxites.

The problems connected with the intrusion of the grano-diorite, and with its contact-effects are many and varied, so that the district is one of exceptional geological interest.

Ordovician.

Ordovician rocks were first recorded from this district by Mr. J. E. Carne, F.G.S., Assistant Government Geologist.* The point at which he met with them was near the Tolwong Mine, on the banks of the Shoalhaven River, about 8 miles S.S.E. of Marulan.

Subsequently an extensive outcrop was found by the author at the Razorback, a long spur extending southwards between the Shoalhaven River and its tributary, Barber's Creek. Hence the rocks can be traced in a northerly direction to within half a mile of the Great Southern Railway line at Morrice's Siding. At this point they disappear beneath the Permo-Carboniferous sandstones. The most conspicuous hill-feature in the district, the Trig. Station, Ballanya, is composed of similar rocks, so that a north and south extension of at least eight miles is indicated for the formation. On the east, they are unconformably covered by Permo-Carboniferous rocks at the northern end. Further south, in the very rugged country forming the Shoalhaven Gorge, they seem to pass into slaty rocks in which no fossils have been discovered. On the west, the area of the Ordovician rocks is limited by the grano-diorite towards the north and by the Silurian strata towards the south.

The chief rock-type is a black carbonaceous shale exactly similar, lithologically, to rocks of this age in other parts of New South Wales and Victoria. These shales pass into quartzites,

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* "The Copper Mining Industry, &c., of N. S. Wales." Mineral Resources No.6, Geol. Survey of N. S. Wales, 1908, p.366.

some of which are very persistent along the line of strike. On the flanks of Ballanya Hill there occurs a banded chert of very striking appearance. It is composed of alternate bands of white and black colours; faulting and folding on a minute scale have taken place, and many hand-specimens illustrate these structures very beautifully.

The formation, as a whole, is intensely folded and crumpled, and all the more solid bands of rock show evidence of this action in the development of slaty cleavage. The finer bands, however, remain in the condition of shales. In these shales an abundant and well preserved graptolite-fauna is developed.

The lower levels of the great Shoalhaven Gorge are composed of highly contorted slates and quartzites. In spite of assiduous search, no fossils have been discovered in this series. They are, however, very similar to the rocks in Limekiln Creek, a small tributary entering the western bank of Barber's Creek, and in this series graptolites have been found. The age of the Shoalhaven beds is thus presumably Ordovician. Their folded character, as compared with the simple tilting of the Silurian beds, is additional evidence of the same fact.

Silurian Rocks.

Silurian rocks, definitely determinable as such, have a very wide range in the district, while rocks presumably of that age cover an even wider extent. Lying to the west of the Ordovician belt, at its southern end, there is a well defined belt of limestones. These extend from a point a little to the north of Hogg's Limekilns, southward beyond Bungonia Caves. At this latter place, they are exposed in a magnificent cliff, 1,700 feet high, forming the bank of Bungonia Creek.

Their northerly extension is interrupted by the Glenrock grano-diorite, which has cut them off there. As this eruptive rock is later than Silurian, the limestones have suffered intense metamorphism, and few traces of fossils are recognisable. At the lime-kilns, however, distinct traces of coarse *Favosites* and of *Tryplasma* show the age of the beds to be Silurian. Further south, at Bungonia, fossils are more numerous, and *Heliolites* and *Stromatopora* are additional forms represented there. Eastwards, the Silurian rocks are interrupted by the Ordovician belt, while their western limit has not been traced fully. It is partly outlined by a belt of porphyritic rocks extending from the Glenrock grano-diorite.

The limestones, where they are least altered, are dark blue and compact, but almost everywhere more or less intense metamorphism has obliterated original features and rendered the rock crystalline. To the east of Hogg's Lime-kilns the texture is that of an extremely coarse-grained white marble. Other forms of contact-metamorphism will be referred to later.

The limestones and associated mechanical sediments have a very constant direction; the dip is W. 10° N. at 53° and does not vary much from these figures.

There are two very persistent limestone-horizons of which the lower is the thicker. The section of the Silurian rocks is shown on Plate lxvi. As there indicated, there is a very marked unconformity between the Ordovician and Silurian sediments. The Silurian rocks are tilted but are not noticeably folded, while the Ordovician strata are crumpled into most extraordinary shapes. This alone indicates a decided stratigraphical break between the two formations, but, in addition, in the creek below the limekilns, the unconformity is beautifully shown. The lower limestone bed of the Silurian, dipping westwards, rests directly on the Ordovician slates dipping easterly at high angles.

Devonian.

It is doubtful whether Devonian rocks occur anywhere in the area dealt with in the present paper. Fossiliferous limestones of Devonian age are known to occur at Windellama, about 22 miles to the south. The geological map of New South Wales shows Devonian right up to Bungonia Creek. A belt of limestone, quite different in character from the Bungonia limestone, occurs to the west of the latter. It is possible that this is the continuation of the Windellama bed. Rocks of this type have not been identified, however, north of Bungonia Creek. The possibility, that the rocks in the Shoalhaven Gorge may be Devonian and not Ordovician, must be recognised.

Permo-Carboniferous.

Between the sediments so far mentioned and those which succeed them, is a very strong stratigraphical break, indicating the lapse of a vast interval of time. Permo-Carboniferous rocks rest, with very strong unconformity, on the upturned edges of Ordovician and Silurian (and possibly Devonian) sediments, and on the eroded surface of the Glenrock grano-diorite. Our district is almost the extreme south-westerly limit of Permo-Carboniferous rocks, and, naturally, the formation is comparatively thin and somewhat abnormal in character.

Its base shows an extremely irregular line of junction with the older rocks, indicating that the newer sediments were deposited upon an eroded surface of considerable relief. Near Bungonia Caves, the Lime-kilns, and on the Razorback there occur small patches of Permo-Carboniferous rocks not more than a few inches in thickness, the last remnants of a formerly continuous sheet. Northwards and eastwards the formation thickens rapidly, until, at Badgery's Crossing, its representatives form imposing cliffs, over four hundred feet in height.

Of the horizons of the Permo-Carboniferous systems in the type-district (Newcastle-Maitland), two are represented at Tallong, namely, Upper Marine Beds and Upper Coal Measures.

It is not always possible to distinguish between these, as both alike are composed chiefly of very coarse conglomerates. Locally the conglomerates pass into sandstones which are fossiliferous. Elsewhere lenticular shale-masses are intercalated in the conglomerates. The conglomerates are very variable in thickness; natural sections (Coal Mine Hill, Badgery's Crossing, etc.) expose thicknesses up to 400 feet.

Immediately in contact with the older rocks the conglomorate passes into a breccia (Badgery's Crossing), composed of fragments of the basement. At the locality mentioned, this has a thickness of 200 feet. In the conglomerates the most abundant pebbles are of black graptolite-slate, reef-quartz, and quartzite.

The upper portions of the cliffs forming the northern side of the Shoalhaven Gorge are composed of white, coarse-grained sandstone, very like Hawkesbury Sandstone in general appearance. Mr. R. S. Bonney expressed doubt as to its Triassic age, and succeeded in discovering the cast of a Spirifer (*S. duodecimcostatus*?) in the sandstone of Portion 15, Parish Bumballa, thus proving its Permo-Carboniferous age.

Like the Upper Marine Beds, the Upper Coal Measures consist mainly of conglomerates and sandstones. Lithologically there is no distinction between the rocks of the two horizons; they can be separated only by stratigraphical evidence.

At Coal Mine Hill there is a band of highly bituminous shale passing into impure coal. This has been prospected by means of an adit, now collapsed. The shales are crowded with fragments of plant-fossils, none of which are sufficiently preserved for specific determination. This shale-bed is evidently part of a well defined coal-horizon, since at Tallong Station, two diamond drill bores passed through a seam of inferior coal. The poor quality of the coal is not to be wondered at, since it was produced at the very border of the coal-swamps, and, therefore, was subject to contamination by land-derived material.

Frequent intercalations of shale in lenticular beds are found in the sandstones and conglomerates. These are crowded with macerated plant-material, but only in one place, a limited bed in the railway cutting just east of Tallong Station, have recognisable fossils been obtained. At this point, plentiful leaves of *Nöggerathiopsis* occur with one or two specimens of *Glossopteris*. The relative abundance of the former species may be explained by the fact that the land to the south and west was clothed with coniferous trees like *Araucarioxylon*, which is now regarded as, possibly, the parent-tree of *Nöggerathiopsis* leaves. It is rather remarkable that fossil coniferous wood is not abundant; probably the stream-currents were strong enough to sweep fallen trees further into the lagoons before they became water-logged, while the leaf-bearing shale-patches represent local basins or clay-pans on the old sand-banks, which received their organic contents mainly through wind-action.

Hawkesbury Series.

It is very doubtful whether rocks of the Hawkesbury Series occur anywhere in the area under consideration. The Geological Map of the Colony (1893 edition) shows Hawkesbury Sandstone right up to the Shoalhaven Gorge. Mr. Bonney, who has made a special study of the lithological features of the Hawkesbury sandstone, is of opinion that the whole of the rocks of Tallong differ essentially from typical occurrences of that formation. The discovery of *Glossopteris* and *Nöggerathiopsis* at Tallong itself shows that, there at all events, the conglomerates and sandstones are of Permo-Carboniferous age.

At Moss Vale, 20 miles north of Tallong, Wianamatta Shales are strongly developed; approaching Werai (3 miles from Moss Vale) they are intruded and covered by basalt-dykes and flows, which become very extensive between Werai and Exeter. From Exeter to Bundanoon, Wainamatta Shales again become the dominant surface-rocks. At Bundanoon the shales are underlain by Hawkesbury Sandstone. Hence to Tallong nothing is seen but sandstone and conglomerate. I understand* that, at Bundanoon, the base of the Hawkesbury Sandstones is sharply defined by the occurrence of a thin bed of chocolate shale. This bed is not visible from the train, and it is difficult, if not impossible, to draw accurately the line of demarcation between the two systems. Quite a distinct change in general aspect of the sandstones is noticeable between Bundanoon and Wingello, and the line is provisionally placed between these two Stations.

Cainozoic Sediments.

On the extreme east of the area dealt with in the present paper, there occur small areas of Tertiary leaf-beds, associated

* *fide* C. A. Süssmilch.

with basalts and tuffs. These have been described by Jaquet and Deane.*

In a former paper by Mr. Taylor and the author,† the physiography of the district was described in some detail. It was there pointed out that the general surface of the country is a peneplain at an altitude of about 2,000 feet above sea-level, with residuals of an older and higher level at about 2,300 feet. The lower levels may be regarded as a series of "mature valleys," rather than a peneplain by some physiographers. The troughs of this lower level are, to a large extent, filled with alluvial waste, varying from the coarse auriferous gravels of Digger's Creek, to the fine clays of Kettle's Flat, and Woolshed Flat. Such deposits as these cover quite extensive areas in the north-eastern portion of Glenrock Station. Along the banks of Barber's Creek, for some little distance above Glenrock Falls, these alluvials have been cut into by the rejuvenated stream, so that they now stand as high-level terraces about 27 feet above the creek-bed. Derived, as it is chiefly, from the waste of the conglomerate, this recent wash makes it extremely difficult to trace accurately the boundaries between Permo-Carboniferous rocks and the other formations of the district.

Eruptive Rocks.

The eruptive rocks of the district form a very interesting group embracing a considerable variety of types. They belong to two periods, Pre-Permo-Carboniferous plutonic and hypabyssal rocks of the grano-diorite series, and Cainozoic basaltic dykes and flows.

The first set is typified by the grano-diorite of Glenrock, the granite-porphyry of Morris Trig. Station, and the quartz-por-

* Jaquet, J. B., "The Iron-Ore Deposits of N. S. Wales." Monograph of N.S.W. Geological Survey, p. 95.

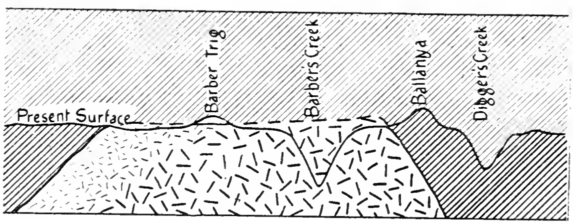
Deane, H., Rec. Geol. Survey of N. S. Wales, Vol. vii., pp.59-65, pl.16,17 (1902).

† Woolnough, W. G., and Taylor, T. G. "A striking example of River-Capture in the Coastal District of N. S. Wales." Proc. Linn Soc. N. S. Wales, 1906, Vol. xxxi., pp. 546-554, pl. xlii.-xliii.

phyry of Marulan. These are not independent rock-masses, but are all closely related; and these relations exhibit some other remarkable features. As the map(Plate lxv.) shows, the Glenrock grano-diorite forms a roughly elliptical mass about five miles by two miles in extent. Its northern end is traversed by the railway line from near the Barber's Creek viaduct almost to Marulan Station. It yields typical granite-scenery, the surface of the country being dotted with conspicuous granite "tors." The deep gorge of Barber's Creek, from 900 to 1200 feet below the level of the plateau, has been cut, for a length of two miles, out of this very solid rock-material, affording an excellent illustration of the enormous power of running water, when the comparative insignificance of the stream is considered.

On the east and south the plutonic rock is bounded by older sediments, towards which it shows an intrusive contact. North and east it disappears under the more recent Permo-Carboniferous conglomerates. The western boundary is the one which calls for comment. In its northern and southern portions the boundary line of the grano-diorite is quite indistinct; the rock passes by insensible gradations through granite-porphyry to quartz-porphyry. There is no doubt at all that the three rock-types represent different phases of the same magma, cooled under different conditions. The transition generally extends over about 300 yards to 400 yards, though here and there it is slightly more abrupt. The cause of this gradation will be discussed below.

In the central section of the western boundary, the eruptive rock is in contact with slates and quartzites showing very strong contact-metamorphism. No trace of fossils has been found in these slates, so that their age is quite indeterminate. In the map they have been shaded in the same way as those strata whose age is certainly Silurian; it is, however, quite possible that they are Ordovician, though they lie considerably to the west of the line along which Ordovician rocks are known to occur. This mass of slates extends over an area two miles by one mile, in a continuous mass. All round its borders there occur large and small patches of similar slaty rocks completely detached from the main area, and isolated from it by bands of eruptive rock. The largest of these isolated masses occurring near the Marulan Show Ground is nearly 500 yards in length, and, from this, pieces down to less than one inch in diameter can be traced. The smaller pieces are certainly "Daly-masses," fragments stoped off from the roof of the magma-chamber during the closing periods of active intrusion. It is difficult to conceive that a mass as large as the slate-area on which Barber's Trig. lies could have been stoped off in this way. The form of the boundary between it and the grano-diorite suggests a different explanation. The junction-line nearly follows the contour of the ground-surface, showing that the surface of contact is an almost horizontal plane; and I suggest that we have here the *last undenuded remnant of the roof of a laccolite or batholith.* The eruptive material has been bared by denudation quite recently (geologically speaking) and we should expect to find the phenomena described by Daly.* As a matter of fact, the grano-diorite is full of angular slaty fragments, even at distances of a mile and a half from the present contact; it is probable, however, that the distances of such points from the original roof is much less (see text-fig.)



Sketch-section to show probable original form of the plutonic mass, and especially its flat upper surface.

To summarise, then, we have a long, rather narrow, band of coarse plutonic rock, trending in a meridional direction, intrusive into the sediments whose strike is in the same general direction.

* Daly, R. J., Amer. Journal of Science, 1903.

On its eastern boundary the intrusive rock is coarse, on its western boundary it graduates into a fine-grained porphyritic phase. Near the western margin are very numerous and extensive "Daly-masses," the size and abundance of these stoped portions decreasing as we pass eastwards. It seems probable that the plutonic mass has the form of a somewhat sill-like mass with an underlay to the west, and that portions of the original roof still exist on the western side.

By the above statement I do not wish to imply that the granodiorite forms a sill in the ordinary sense of the term. Its junction with the sediments is much too irregular to support any such theory. It seems, however, to have forced its way surfacewards in a general way conformably with the westerly dip of the Silurian rocks. If this interpretation is correct, the igneous intrusion differs from any of those types mentioned by Iddings, in his paper on "Bysmaliths."*

The age of the granitic rocks cannot be determined with very great accuracy. They are certainly Post-Silurian, and certainly Pre-Permo-Carboniferous. To the south of the area dealt with in the present paper, rocks of Devonian age occur at Windellama. These are apparently conformable with the Silurian rocks. It is probable that the Glenrock granodiorite is Post-Devonian. If so, it must belong to some part of the Carboniferous, during which time the injection and extrusion of acid eruptive rocks was extremely active in Eastern Australia.

Wingello Basalts.

These rocks have not been studied in detail in the present contribution. Jaquet† has mapped and described them to some extent. For the most part, they form flows filling in shallow valleys of Tertiary age. The contact between them and the underlying Permo-Carboniferous sandstones is marked in places by intense silicification of the latter rocks, which have been

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* Iddings, J. P., "Bysmaliths." Journal of Geology, vi., 1898, p.704.

†Jaquet, J. B., "The Iron-ore Deposits of New South Wales." Memoir of Geol. Survey of N. S. Wales.

converted into a dense, glassy quartzite. This effect is very well marked in Portion 15, Parish Bumballa, at a spot called "Devil's Hole"; and again, some distance further to the east, near the summit of Badgery's Track.

At a local centre of eruption on Portion 16, Parish Wingello, basaltic tuffs are developed, which, by alteration, have given rise to pisolitic bauxite. In these tuffs Tertiary leaves are preserved.*

Dykes are not very numerous in the district, but one occurs at Badgery's Lookdown. Where it intersects the hard Permo-Carboniferous sandstones and breccias, it has yielded to atmospheric influences more readily than the surrounding rocks, and forms a deep cleft in the pinnacle which constitutes the Lookdown. Below the Permo-Carboniferous rocks it forms a structure which resists denudation better than the Ordovician(?) slates, and is responsible for the long spur by means of which Badgery's Track descends to the Shoalhaven River. The continuation of this dyke on the southern side of the river has not been traced.

Contact-Metamorphism at the grano-diorite boundary.

The contact-phenomena round the margins of the plutonic massif are very striking. As we should naturally expect, it is chiefly at the limestone-contact that the greatest effect is produced.

At Hogg's lime-kilns the limestones, though moderately crystalline, have scarcely been converted into marble. Remains of fossils are still indistinctly visible. Following the western limestone belt northwards to its contact with the eruptive mass, no very great alteration is noticeable until that point is almost reached. At the actual junction between the marble and the eruptive rock, the latter is somewhat fine-grained and porphyritic, and one does not meet true grano-diorite for nearly 100 yards. The alteration in the limestone has followed parallel bands, 2-10 centimetres wide, converting them into fine-grained grey chert.

* Deane, H., Records of Geol. Survey of N. S. Wales, Vol. vii., Pt.2, pp.59-65, Pls.16,17(1902).

The different hardnesses of the various bands produce a very striking effect on weathered surfaces. On the eastern boundary of the western limestone-belt, where the grano-diorite is closer to the contact, the alteration is more profound; the limestone has been recrystallised to a dense white marble, with abundant silicates—colourless wollastonite, and yellowish-brown grains of garnet.

The tongue of eruptive rock which extends southwards from the main mass along the edge of Barber's Creek gorge, has altered the eastern band of limestone much more profoundly than the western one. At a point east of the lime-kilns, the whole width of the belt consists of extremely coarse, saccharoidal marble, the grain-size approaching 2 centimetres in places. In its superficial portions this marble is very friable, but boulders found in a creek which passes through it, indicate that, below the limits of surface-weathering, it is dense and snow-white.

Traced in a southerly direction, the metamorphism gradually decreases, though even at Bungonia Caves, 4,000 yards from the grano-diorite contact, the rock is still somewhat crystalline. Traced in a northerly direction, the saccharoidal character continues almost up to the contact. The actual contact-line is indefinite, as there is a band of silicate rock passing gradually into marble on the south, and into grano-diorite on the north(see p.799).

A similar type of alteration, on a smaller scale, is met with at the small patch of limestone to the east of Barber's Creek Falls.

The slates and quartzites of the Barber's Trig. mass are considerably metamorphosed round their eastern fringe, being converted into dark hornstones.

Certain small patches of dense white quartzite occur quite irregularly over the surface of the limestones, just to the south of the lime-kilns. These do not form connected beds or veins in the limestone-series, but seem to occur quite sporadically. I am of opinion that they represent small undenuded remnants of Permo-Carboniferous quartzite formed in the same way as those at Devil's Hole(p.792). Against this idea is the fact that no trace of associated basalt-flows has been found.

Petrology of the Eruptive and Metamorphic Rocks.

G r a n o - d i o r i t e : Glenrock Falls. (Plate lxix., fig.1).

The rock is phanero-crystalline, with an apparent average grain-size of about 2mm. Body-colour light grey, due to mixture of black, grey, and white minerals. Structure, granitic. Minerals distinguishable :—greenish-grey plagioclase, pinkish orthoclase, clear quartz, plentiful black hornblende (and hypersthene, which is not distinguishable from the hornblende macroscopically) and small quantities of shining biotite.

Under the microscope we have :—Texture, holocrystalline, phaneric, average grain-size 0·75 mm.; hypidiomorphic granular. Minerals present, and approximate percentages—plagioclase 35, quartz 25, orthoclase 15, diopside and uralite 8, hypersthene and bastite 5, hornblende 5, biotite 5; remainder— magnetite, zircon, apatite, and epidote.

Plagioclase is in strongly idiomorphic crystals up to 2 mm. by 1·5 mm., strongly tabular in habit, and very beautifully zoned. Albite-twinning is universal; many individuals show pericline and Carlsbad twinning also. The inner zones consist of basic andesine, about Ab_4An_3, giving symmetrical extinctions in the brachypinacoid zone up to 23°, with a difference between the halves of a Carlsbad twin amounting to 5°. The outer zones consist of oligoclase, andesine about Ab_3An_2, with symmetrical extinctions of 8°. These crystals are considerably decomposed, particularly in their central portions, to interlacing fibres of sericitic mica.

The quartz is completely allotriomorphic. It is entirely free from strain-effects. No features of special interest are to be recognised.

Orthoclase is in completely allotriomorphic grains, untwinned and almost completely kaolinized.

Diopside is in subidiomorphic crystals of stout prismatic form, mostly intergrown with primary hornblende. The two are always in parallel position, with the pyroxene inside and the hornblende peripheral in position. The diopside is colourless, much twinned in broad lamellæ, and shows extinction-angles up to 45° from the trace of the vertical axis. It is almost all more or less altered to uralite, all stages from incipient alteration to complete replacement by a finely fibrous aggregate of light green uralite being noticeable.

Hypersthene occurs, like diopside, intergrown with hornblende, but no instances have been seen of intergrowth of the two pyroxenes. It is very slightly coloured, and shows very faint pleochroism in pink and yellowish tints. Like the diopside, it is considerably altered, but not to uralite. It gives rise to a cloudy, brown, fibrous aggregate of bastite, with straight extinction between crossed nicols.

In addition to the intergrowth with pyroxene, hornblende forms subidiomorphic crystals up to 2 mm. in length. Its optical properties call for no particular description.

Biotite is somewhat irregular in occurrence, being met with in considerable abundance in some parts of a slide and very scarce in the remainder. It occurs in idiomorphic and subidiomorphic grains up to 0·75 mm. by 0·5 mm.; pleochroism from bright yellow to very dark red-brown. It is somewhat decomposed round the edges and along the cleavages into green pleochroic chlorite (pennine). There are also narrow lenses of colourless mineral (talc ?) along the cleavages.

Magnetite is fairly abundant in large irregular grains up to 0·5 mm. in diameter. A few sharply defined, but minute, crystals of zircon and apatite occur. Order of consolidation—

Zircon and apatite ——
Magnetite ——
Plagioclase ——————
Biotite ——————
Hypersthene and diopside ——————
Hornblende ——————
Orthoclase and quartz ——————

ANALYSIS BY G. J. BURROWS.

	Per cent.	Molecular proportions
SiO_2	59·94	994
Al_2O_3	15·61	153
Fe_2O_3	1·55	10
FeO	6·25	87
MgO	2·53	63
CaO	6·65	119
Na_2O	2·88	47
K_2O	2·06	22
H_2O+	0·57	32
H_2O-	0·39	22
TiO_2	1·08	14
P_2O_5	0·64	4
Total	100·15	

	Per cent.	
Norm. Quartz	15·78	
Orthoclase	12·23	Sub-Rang
Albite	24·63	Bandose.
Anorthite	23·35	
Diopside	5·35	
Hypersthene	11·93	
Magnetite	2·32	
Apatite	1·34	
Ilmenite	2·13	
Total	99·06	

Dacite: near southern boundary of Portion 113, Parish Marulan. (Plate lxix., fig.3.)

The rock is porphyritic, with a finely crystalline base. Phenocrysts up to about 10 mm. diameter constitute about 40 per cent. of the material. Body-colour greenish grey. The most conspicuous minerals are large glassy quartz-grains, slightly opaline in places, rather scarce; greenish-white, dull grains of felspar; and aggregates of dark ferromagnesian mineral.

Microscopic characters: holocrystalline porphyritic, groundmass panidiomorphic-granular, with average grain-size of about

0·09 mm. Phenocrysts of plagioclase, hypersthene and quartz and nests of uralite. Groundmass consists of orthoclase, quartz, and biotite.

Plagioclase: idiomorphic crystals 1 mm. to 3 mm. in length, with sharply defined outlines. These are very much decomposed, and it is extremely difficult to recognise internal structures. External form shows that the mineral is twinned on the Carlsbad law, and traces of albite twinning can be detected also. Rather unsatisfactory measurements of extinction-angle and refractive index indicate that this felspar is a little more acid than that described for the grano-diorite. One would expect the two to be the same, if the conclusions arrived at above (p.795) are correct.

The occurrence of hypersthene is very remarkable. It is fairly abundant in the slides in irregular masses up to 3 mm. in diameter, forming a perfect network filled with quartz and orthoclase grains identical with those of the base. The whole network is optically continuous; in other words, the hypersthene phenocrysts are pœcilitic towards the groundmass (Plate lxix., fig 3). This is somewhat remarkable considering the order of crystallization determined for the grano-diorite. Smaller individual crystals of hypersthene up to 1 mm. in length also occur. The pleochroism, if present, is very slight indeed.

No diopside is seen in this rock; it is probably represented by aggregates of uralite. It is extremely difficult to distinguish between primary and secondary hornblende in this rock. It is probable that a good deal of the amphibole seen is primary.

Quartz is present in the form of occasional grains up to 1·5 mm. diameter. It is very irregular in outline, and contains bays of the groundmass.

Biotite appears to be rather one of the minerals of the groundmass. It occurs in individual crystals, from 1 mm. to 0·3 mm. in length, sometimes forming larger aggregates. The little crystals are sharply defined.

In addition to biotite, the groundmass consists of a granular mixture of quartz and orthoclase. Both minerals show traces of idiomorphic boundaries.

Analysis by L. A. Cotton, B.A., B.Sc.

	Per cent.		Molecular proportion
SiO_2	73·54	...	1226
Al_2O_3	10·95	...	108
Fe_2O_3	1·08	...	7
FeO	4·39	...	61
MgO	0·08	...	2
CaO	1·68	...	30
Na_2O	2·79	...	45
K_2O	4·80	...	51
H_2O+	0·21	..	—
H_2O-	0·08	...	—
TiO_2	0·60	..	8
Total	100·20		

		Per cent.	
Norm.	Quartz	33·60	
	Orthoclase	28·36	Sub-Rang
	Albite	23·58	Tehamose.
	Anorthite	3·34	
	Diopside	4·43	
	Hypersthene	3·93	
	Magnetite	1·62	
	Ilmenite	1·22	
		100·08	

In spite of the very wide differences in the analyses of the grano-diorite and the dacite, I feel confident, from field-evidence, that the two are genetically related. The differences probably express magmatic differentiation.

Series of specimens taken from the contact between lower limestone-bed and grano-diorite.

The numbers read consecutively from south to north. There is a long gap between the last distinct outcrop of unsilicified marble, and the first of the contact-series (No. 1), which is somewhat siliceous. Taking this specimen as the origin for distances, the other specimens were situated as follows:—

No.2	5 feet	No.7.	26 feet
No.3...	9 feet	No.8.	31 feet
No.4....	15 feet	No.9.	32 feet
No.5....	18 feet	No.10.............	180 feet about.
No.6..	22 feet		

No.1. Coarse granular marble, composed almost entirely of calcite with a little light yellow garnet, and a few flakes of phlogopite.

No.2. Coarsely granular rock of very striking appearance. Macroscopically it has an apparent grain-size of about 3 mm. It is composed chiefly of a pearly-white prismatic mineral with perfect cleavage (wollastonite), and a dark reddish mineral without cleavage, which, in the field, was taken for garnet, but which is really vesuvianite. (Plate lxix., fig.2.)

Under the microscope, the most abundant mineral is vesuvianite, in large poikiloblastic grains up to 12 mm. by 10 mm. These are optically continuous throughout, though very ragged in form. Some are so crowded by large grains of garnet and opacite as to approach sieve-structure. In thin sections the colour and pleochroism, though noticeable, are not very intense; in a section 0·075 mm. thick, the pleochroism is very strong, O faint yellow, E bright rose-red. Double refraction is extremely weak, and even thick sections give only a peculiar azure tint between crossed nicols, and scarcely alter the interference-colour of a gypsum-plate, giving red of the first order. The optical sign is *positive* throughout, and therefore abnormal.

Next in order of abundance is a colourless pyroxene mineral, probably wollastonite. Most of the characteristics agree perfectly well with those of that mineral; colour, cleavage, refractive index, double refraction, axial angle, optical sign, and dispersion are quite normal. A point of interest is, that cleavage-chips show quite a constant small departure from straight extinction: they all extinguish at an angle of 3° from their length. A considerable quantity of the mineral was isolated, and analysed by Mr. A. B. Walkom with the following result :—

SiO_2	50·71
Al_2O_3	2·07
Fe_2O_3	0·69
MgO	0·07
CaO	46·53
Total	100·07

There can be little doubt, then, that the mineral is wollastonite; but I can suggest no explanation for the slightly oblique extinction-angle above noted. Inclusions in the wollastonite are very abundant in the form of relatively large rounded grains of vesuvianite.

It is possible that there is a second pyroxenic mineral like malacolite present in small quantities; but, if so, its distinction from the wollastonite is very difficult. Certain grains appear to be too strongly birefringent to be classed as wollastonite, and possess the cleavage of malacolite, but in no case could an optically positive figure be obtained.

A little colourless and slightly decomposed scapolite is present in the form of ovoid grains.

The groundmass of the rock is a greyish-yellow laminated mass of mineral, with an internal parallel fibrous structure. The fibres are at right angles to the laminæ, which are constant in direction throughout the whole slide. This mineral is not perfectly isotropic; in thick sections it is faintly birefringent, but the double refraction is even lower than that of vesuvianite. It is probable that this material is incipient garnet, since, in specimens a little closer to the granite-boundary, garnet becomes the most abundant mineral. Even in this rock there is a little light yellow garnet intergrown with the vesuvianite, as above noted.

There is a small amount of yellowish phlogopite-mica in rounded flakes, and considerable interstitial calcite.

Analysis by W. R. Browne.

	Per cent.
SiO_2	44·82
Al_2O_3	5·94
Fe_2O_3	3·17
FeO	1·26
MgO	1·31
CaO	41·21
Na_2O	0·26
K_2O	0·06
H_2O+	0·26
H_2O-	0·14
CO_2	—
TiO_2	0·41
MnO	0·13
Total	98·97

No.3 is intermediate in character between 2 and 4.

No.4 is a dark, very hard and heavy rock, with a somewhat resinous lustre. The most conspicuous mineral is reddish-brown garnet, in large masses; next in order of abundance, is bright green pyroxene. Small amounts of white calcite and quartz are also visible.

Under the microscope, the rock is seen to consist essentially of yellow garnet, much cracked and crowded with microscopic inclusions of calcite and sericitic mica, and including small amounts of other minerals. The garnet is mostly without crystal form, but towards quartz and calcite it is strongly idiomorphic. From other specimens obtained, it would appear that well crystallised garnets, showing combinations of (110) and (122), are developed on the walls of cavities; and that these cavities, in some cases, have been filled in with quartz or calcite.

Malacolite is present but not abundant, in irregular grains and subidioblasts, mostly about 1 mm. by 0·5 mm. It is colourless to slightly greenish, and shows pinacoidal cleavages in addition to those parallel to the prism. Some of the grains are extremely ragged, and are filled with ovoid grains of garnet, yielding a poikiloblastic structure.

The presence and mode of occurrence of quartz and calcite have been noted above. (Plate lxix., fig. 5.)

Analysis by A. B. Walkom.

	Per cent.
SiO_2	39·49
Al_2O_3	15·97
Fe_2O_3	7·09
FeO	2·59
MgO	1·97
CaO	31·60
K_2O	absent
Na_2O	0·12
H_2O-	0·04
H_2O+	0·13
TiO_2	1·01
CO_2	0·17
MnO	0·32
Total	100·50

No.6 is an even-grained rock of about 1 mm. to 1·5 mm. grain-size. In handspecimen the rock is dioritic in appearance, but is very much too high in specific gravity for any eruptive rock. The only mineral very clearly recognisable is a black pyroxene with marked lustre mottling. Small amounts of whitish minerals are also present, and, on close examination, the resinous garnet intergrown with the pyroxene can be seen.

Under the microscope the texture is diablastic, the rock consisting chiefly of a green pyroxene approaching fassaite. This is diablastically intergrown with pinkish garnet slightly different in appearance from that so abundant in the last rock described. A small amount of colourless zoisite also enters into the diablastic intergrowths. Some of it is quite clear, some altered into cloudy radial aggregates of fine fibrous mineral. There is a very little mica(phlogopite), and a small amount of secondary calcite (Plate lxix., fig.6).

No.7. In handspecimen this rock does not differ essentially from No.6, except that large isolated masses of red garnet occur sporadically through it.

Under the microscope it is a dark green, granoblastic rock, with uniform grain-size about 0·27 mm. It consists almost entirely of dark green pyroxene, which, in thick section (0·07 mm. thick) is decidedly pleochroic. The pleochroism suggests an amphibole, but cleavage, and optic orientation and sign are those of a pyroxene. The pleochroism is peculiar—$\mathfrak{a}$ = dark green; $\mathfrak{b}$ = yellowish-green; $\mathfrak{c}$ = dark green.

There is a little sphene of two distinct types: i. dark yellow, semiopaque and probably primary; ii. greyish and transparent, probably secondary. A small amount of quartz, interstitial in character, appears to be secondary. There is a very small amount of a greyish aggregate, very fine-grained and nearly opaque; this is probably completely saussuritized (or sericitized) felspar. One striking feature is the relative abundance of apatite in the form of large, clear crystals, up to 0·8 mm. by 0·075 mm.

The line of demarcation between the eruptive and sedimentary rocks probably lies between Nos. 7 and 8 of this series; hence it is best to consider the remaining three specimens in reverse order.

No.10 is the normal grano-diorite. Macroscopically it differs from the Glenrock type in being a little more leucocratic in aspect. While this is so, the individual dark minerals are somewhat larger than in the other rock. Microscopically it is very similar to the type-rock from Glenrock Falls (p.795). One point of difference is the form and character of the felspar. There is no orthoclase at all, and the plagioclase is relatively basic, and is very strikingly idiomorphic. It is strongly zoned, the kernel varying from labradorite at the centre, to andesine on the outer part; and this kernel is surrounded by an untwinned, but optically continuous zone of felspar, whose refractive index is a little higher than that of quartz, and, therefore, classed as oligoclase. The felspars are considerably sericitized, the alteration often being confined to the outer portion of the kernel.

There is no recognisable pyroxene, as there is in the Glenrock type, but hornblende and biotite are quite similar. There is a good deal of zircon and apatite. The ferromagnesian minerals are a good deal chloritized, but not exceptionally so.

Quartz is thoroughly interstitial, and is optically continuous over quite wide areas, so that the structure is markedly poikilitic.

No.9 is evidently the same rock, intensely altered. The body colour is pinkish-grey, from the abundance of pink aggregates of secondary minerals. No quartz can be seen, and the ferromagnesian material is almost entirely hornblendic.

Under the microscope, the most conspicuous departure from the unaltered rock is the entire absence of quartz. This may be due to one of three causes: zonal differentiation may have caused the formation of more basic minerals peripherally, the crystallizing mother-liquor containing the last constituents of the magma to separate (including the quartz) escaped into and caused the alteration of the adjacent limestones, or the magma picked up so much lime from the sediments as to completely absorb all the silica to build silicates.

The minerals present are sufficiently like those of the unaltered grano-diorite as to suggest close relationship. Felspar in abundant but completely clouded for the most part, and converted into milky pseudomorphs giving aggregate polarization. Much of the secondary mineral is sericite. Some of the felspar is not so completely altered as to destroy all traces of twinning; and, though satisfactory measurements cannot be obtained, the felspar is seen to be a basic plagioclase. Hornblende is still recognizable, but is in process of metasomatic alteration. It is much shredded and bleached, and is partially replaced by a colourless pyroxene developed in parallel orientation with it. Biotite is absent, but is represented by nearly colourless chlorite in large flakes and fibrous radial aggregates. Sphene is rather abundant in small crystals and grains, whose distribution suggests that they have been formed as a result of the disintegration of the biotite. Only a little magnetite is visible.

No.8 is probably the same rock as No.9, with increased alteration of the original constituents. Felspars are completely sericitized, no unaltered ones remaining. Secondary mica has gathered into quite large flakes of very irregular outline, besides occurring in a finely granular aggregate through the rock. Hornblende has decreased, and pyroxene has relatively increased so as to be the dominant ferromagnesian mineral present. Chlorite has disappeared, but sphene is almost more abundant than in No.9; and, in addition, there is a notable amount of ilmenite present.

This brief sketch of the contact-phenomena is sufficient to indicate the great interest which attaches to this particular section; and I hope to present a more complete and detailed account of the occurrence in the near future.

Contact-metamorphism of the Ordovician slates by the grano-diorite.

A very good exposure illustrating this phenomenon exists 2000 yards W. from Glenrock Falls. The whole of the rocks forming this slate-area are considerably indurated, but, at the spot mentioned, the contact can be located to within a few inches. Close to the boundary the sedimentary rock has become very dense and heavy, and dark in colour. On slightly weathered surfaces it has a somewhat silky lustre, owing to the occurrence of abundant submicroscopic flakes or needles of magnetite and micaceous hæmatite.

Microscopically it shows a distinct "hornfels" structure. The grain-size is even, about 0·045 mm. The rock consists essentially of a quartz-mosaic of completely interlocking grains. There is a small amount of mica (muscovite), which, though slightly yellow, is nonpleochroic. This occurs in ragged flakes of the same order of size as the quartz-grains. The colourless minerals are crowded with minute flakes and grains of hæmatite and magnetite. At intervals, these minerals are aggregated into dense masses up to 0·4 mm. by 0·04 mm. in size, generally, but not always, associated with muscovite. At first sight these aggregates remind one of the pseudomorphs in magnetite after hornblende, often met with in hornblende-andesites. It is possible that, in the rock under discussion, some mineral has suffered complete alteration, but more probably the aggregations mark incipient formation of some new mineral, which, if completely developed, would have converted the rock into a knotted schist.

Summary.

Sedimentary formations of Upper Ordovician, Silurian, Permo-Carboniferous, andCainozoic ages are certainly represented, and have all yielded fossils. Devonian and Triassic rocks are probably absent.

Two well marked unconformities exist: between the Ordovician and Silurian rocks on the one hand, and between these formations and the Permo-Carboniferous on the other.

Pre-Permo-Carboniferous formations are intruded by a very interesting mass of hypersthene-bearing grano-diorite, which passes peripherally through a granite-porphyry phase into dacite. It is suggested that this represents the top of a laccolitic mass only just exposed by denudation. The grano-diorite is traversed by veins of aplitic and lamprophyric character, probably complementary in chemical composition; and contains many, and sometimes very large, xenoliths.

Tertiary basalts and basalt-tuffs are extensively developed in the eastern portion of the area studied.

Extremely interesting contact-phenomena exist between the grano-diorite and the Silurian limestones; and calc-silicate rocks composed of wollastonite, garnet, vesuvianite, pyroxene, and mica are very extensively developed.

The microscopic structures of the eruptive and metamorphic rocks are described in some detail, and chemical analyses of several types are given.

Conclusion.

In conclusion, I wish to express my gratitude to Professor David, for his ever-ready and sympathetic assistance; to Mr. Dun for help and suggestion; and to many students for help, both in the field and in the laboratory. I would especially mention Messrs. L. A. Cotton, B.A., B.Sc., W. N. Benson, B.Sc.,

L. L. Waterhouse, B.E., R. S. Bonney, B.A., LL.B., W. R. Browne, A. B. Walkom, G. J. Burrows, and W. T. Anderson. I wish also to thank Messrs. H. and A. Rumsey for much local scientific information, and for personal guidance on several occasions.

EXPLANATION OF PLATES LXV.-LXIX.

Plate lxv.

Geological Map of Tallong and Marulan, from the Great Southern Railway Line, on the north, to the Shoalhaven River and Bungonia Creek on the south.

Plate lxvi.

Geological Section, From A to B, on the above Map. Note that the isolation of the Silurian rocks by the grano-diorite is only apparent. Had the line of section been a little further south, this isolation would not have appeared.

Plate lxvii.

Fig.1.—Razorback, looking south. Hills in the foreground consist of Upper Ordovician slates with abundant graptolites. In the distance is the precipitous gorge of the Shoalhaven River, near Tolwong Mine.

Fig.2.—Glenrock grano-diorite, Marulan Creek, showing the jointing of the rock, and the way in which stream-development has been influenced by the presence of an aplitic vein.

Plate lxviii.

Fig.1.—Highly contorted Ordovician(?) slates just below Badgery's Crossing, Shoalhaven River.

Fig.2.—Lower limestone-belt (Silurian), Hogg's Lime-kilns, Marulan.

Plate lxix.

Fig.1.—Microphotograph of Glenrock Grano-diorite(× 23 diameters).

Fig.2.—Microphotograph of Granite-Porphyry, Portion 113, Parish Marulan (× 23 diameters).

Fig.3.—Dacite, southern boundary Portion 113, Parish Marulan(× 23 diameters).

Fig.4.—No.2 of contact-series. Microphotograph(× 23 diameters)

Fig.5.—No.4 of contact-series. Microphotograph(× 23 diameters).

Fig.6.—No.6 of contact-series. Microphotograph(× 23 diameters).

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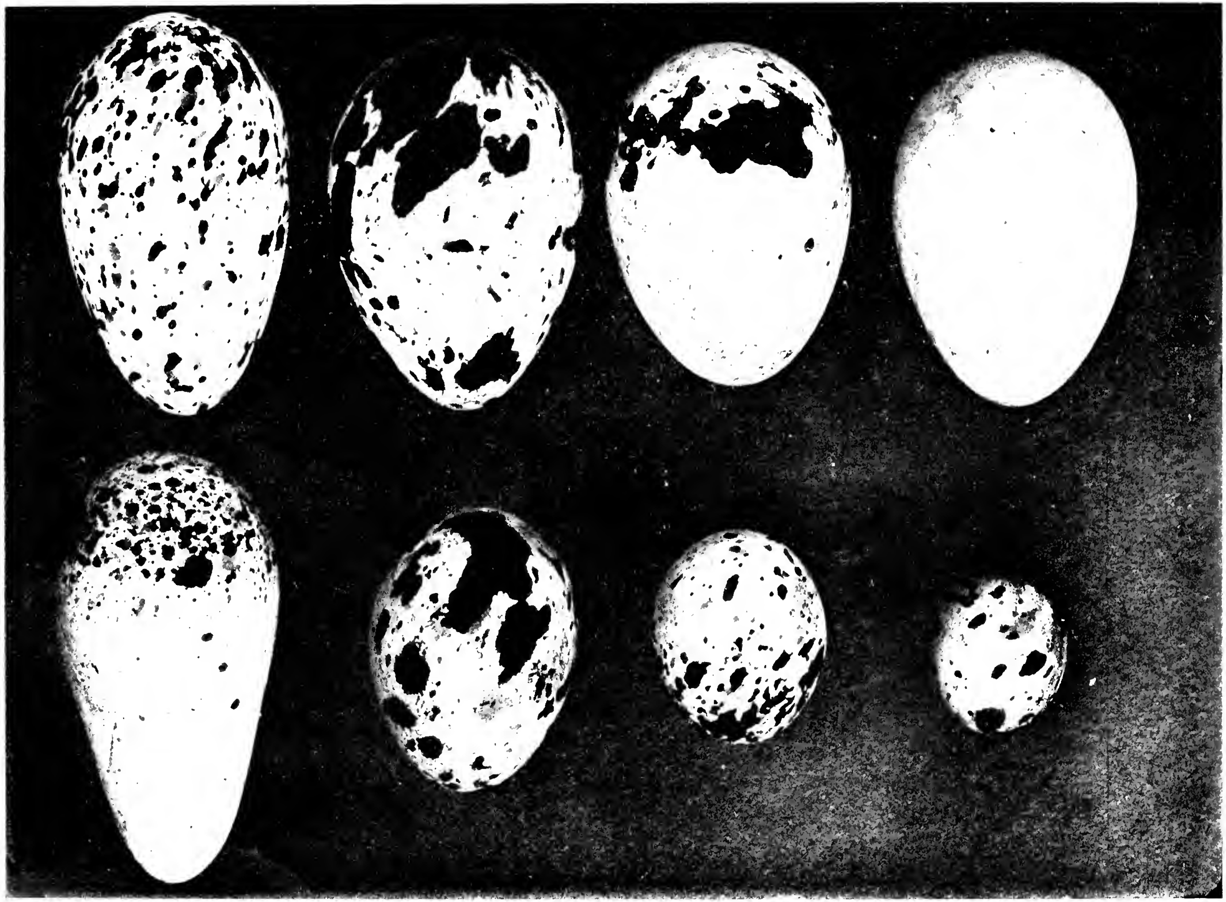
An index of the generic names of the Fucoideæ and Florideæ (pp.9-57) will be found on pp.57-60.

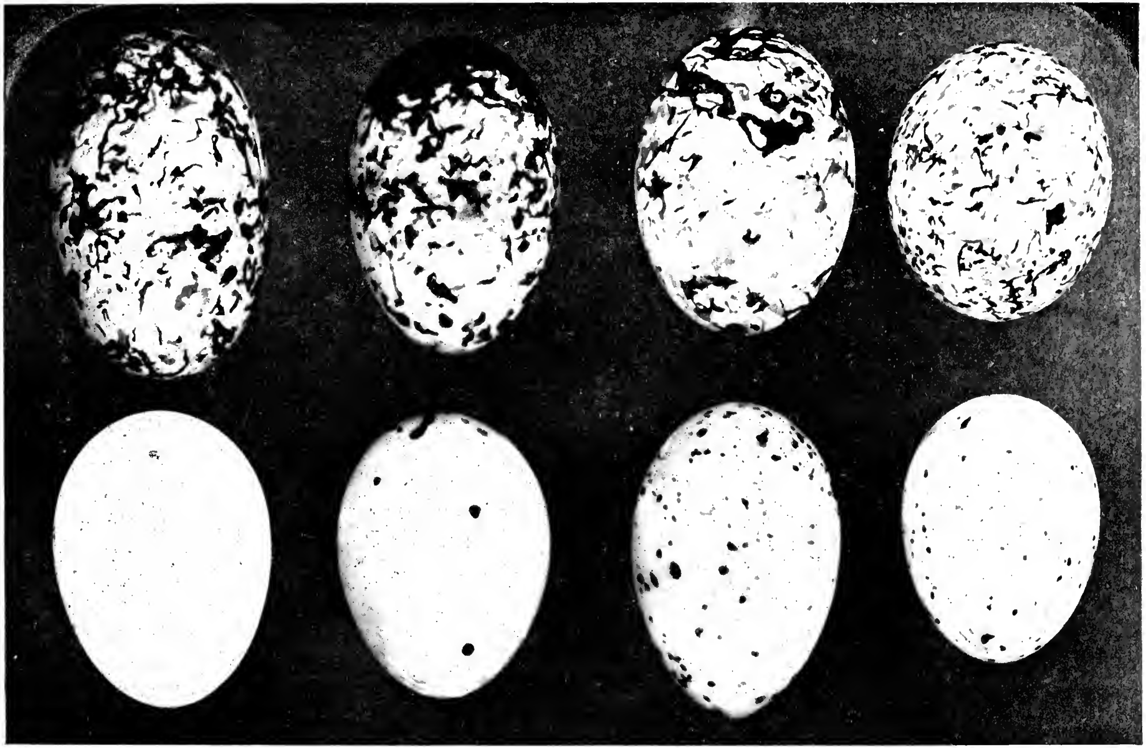
Names in Italics are Synonyms.

[Printed off March 10th, 1910.]

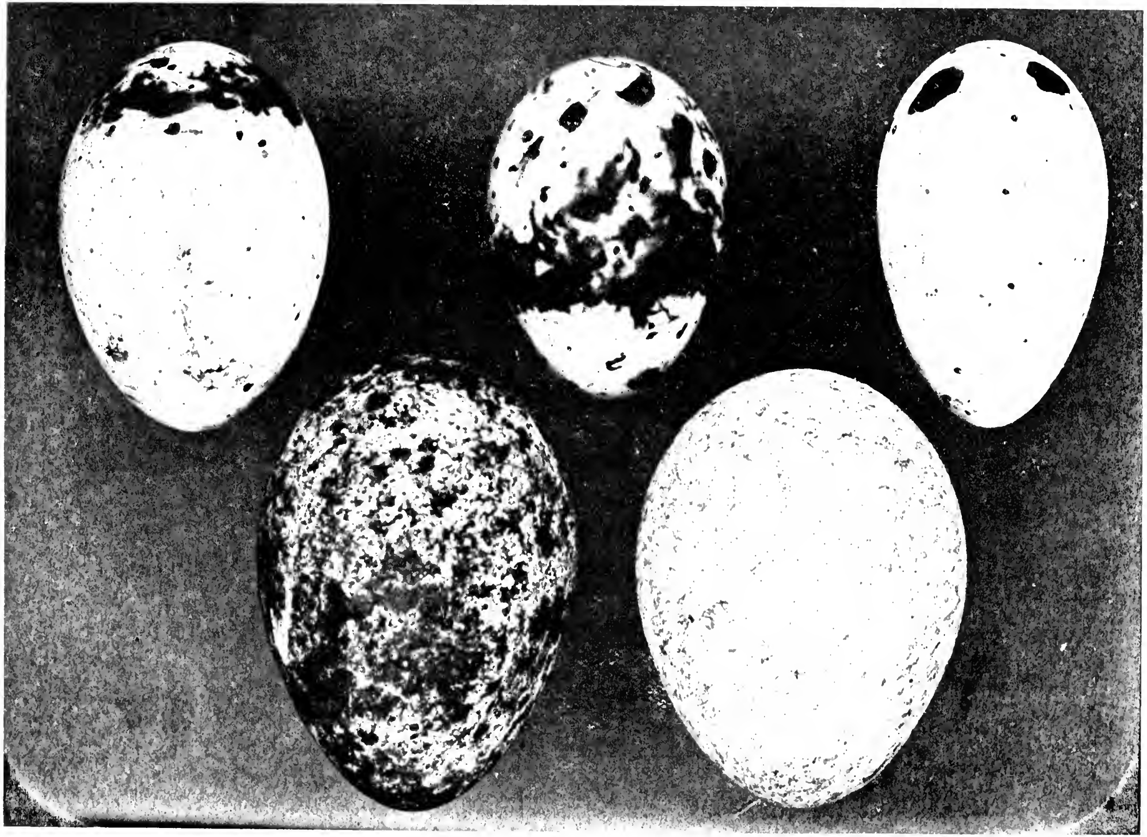
F. Cunninghame & Co., Printers, Sydney.



EGGS OF STERNA FULIGINOSA Gmel.



EGGS OF GYGIS ALBA (upper row); MICRANOUS LEUCOCAPILLUS (lower row, first and second from left); PROCELSTERNA CINEREA (lower row, third and fourth from left)

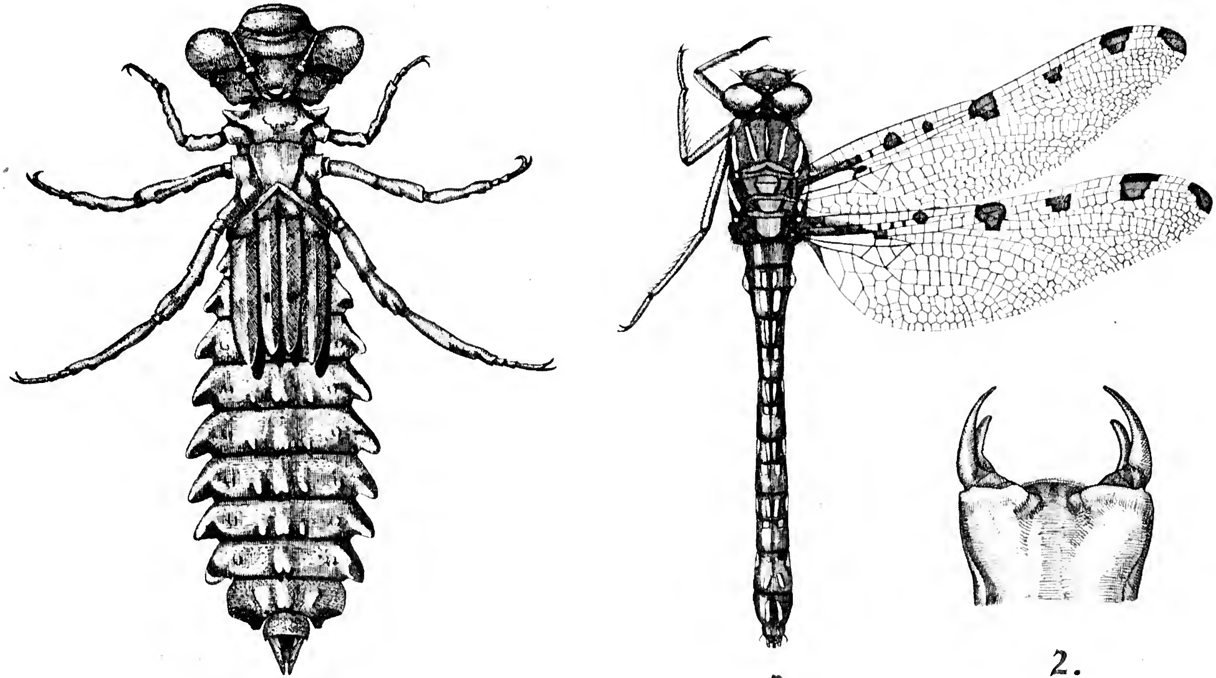


EGGS OF ANOUS STOLIDUS (upper row); PHAETHON ERUBESCENS (lower row).

Fig. 1. Egg of *Gygis alba*, as laid in a knot-hole of a branch.

Fig. 2. Nest and Eggs of *Rhipidura cervina*.

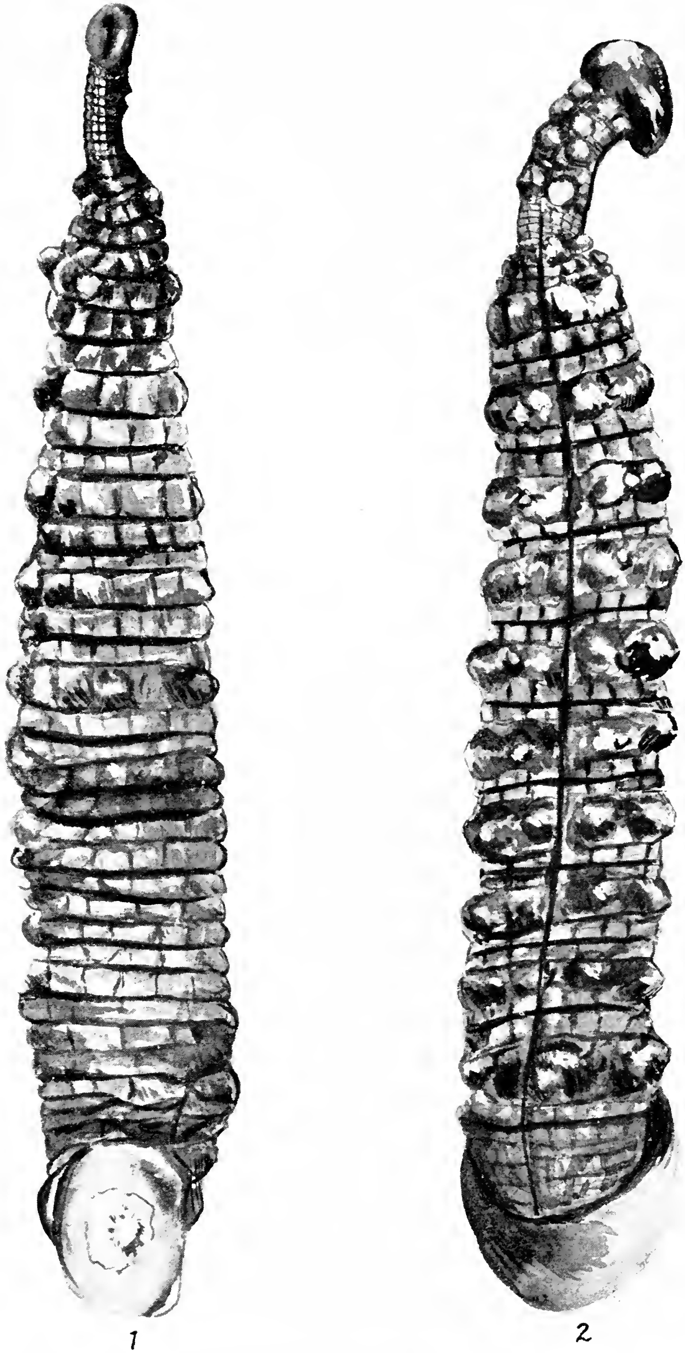
Nest and Eggs of *Pachycephala contempta.*



1. 3. 2.

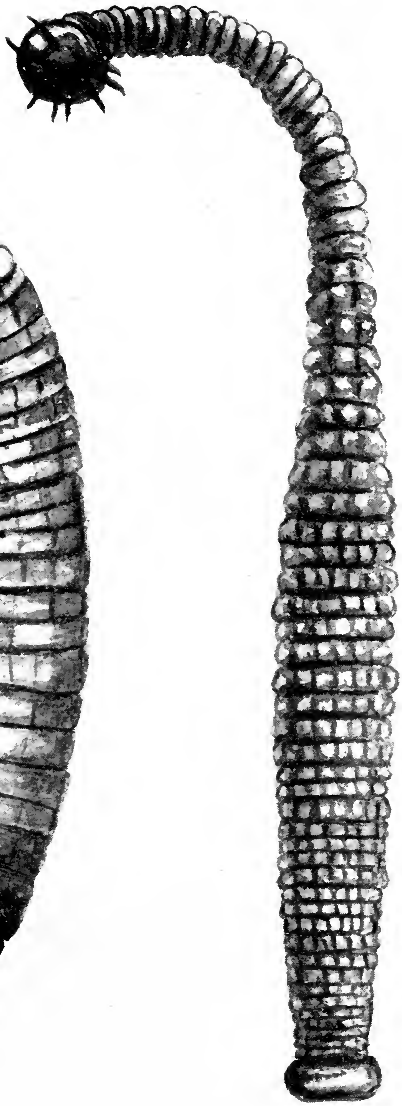
R.J.T. del.

PHYLLOPETALIA PATRICIA, n.sp.



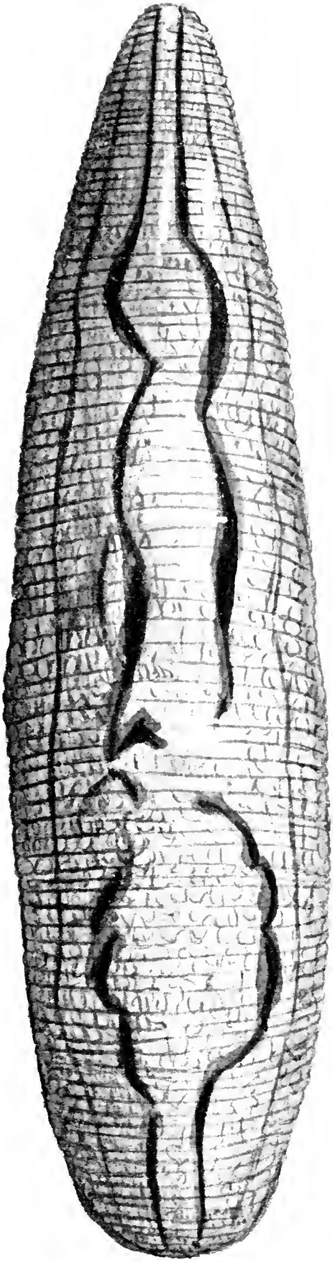
PONTOBDELLA MACROTHELA Schmarda (ventral and dorsal views).

3



4

PONTOBDELLA AUSTRALIENSIS, n.sp. (distended and extended).



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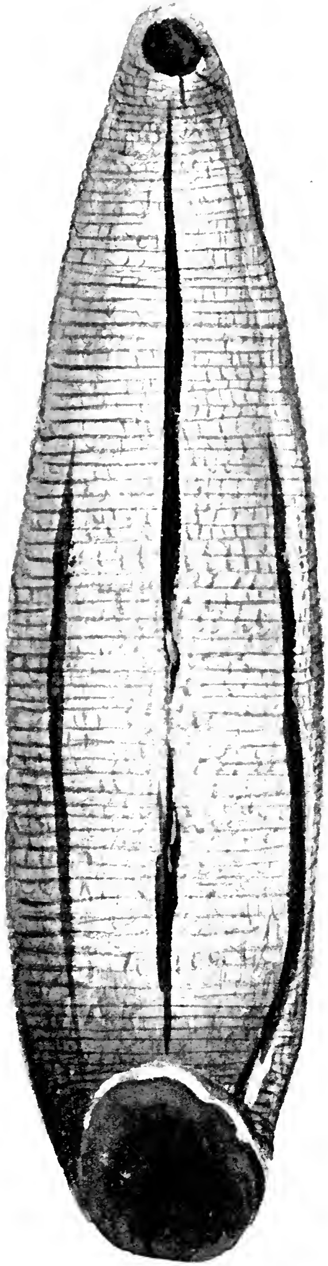


6

GEOBDELLA TRISTRIATA, n.sp. (dorsal and ventral views).

Fig. 1. The Macintyre River, south-east from Elsmore.

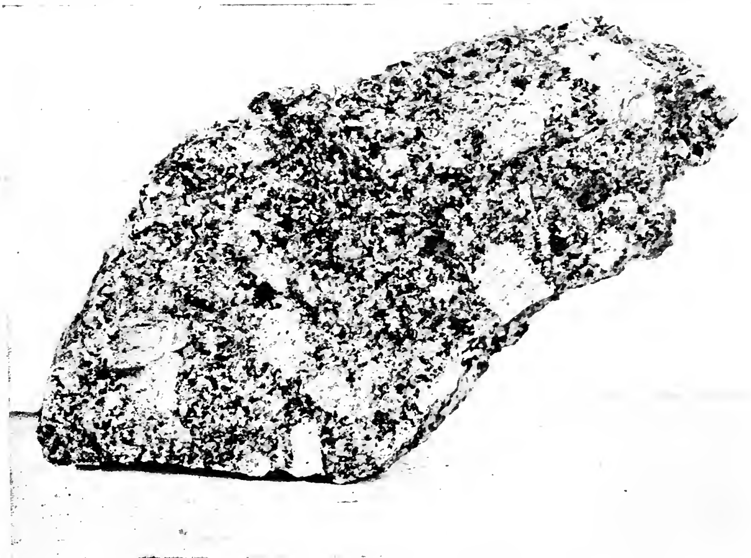


Fig. 2. The Tingha Granite, showing biotite and porphyritic felspars.

Fig. 1. Cemented rock on Elsmore Hill.

Fig. 2. The "Acid Granite," from near Elsmore.

Fig. 3. The "Acid Granite," from King's Gap.

Fig. 1. Elsmore Hill, showing reef.

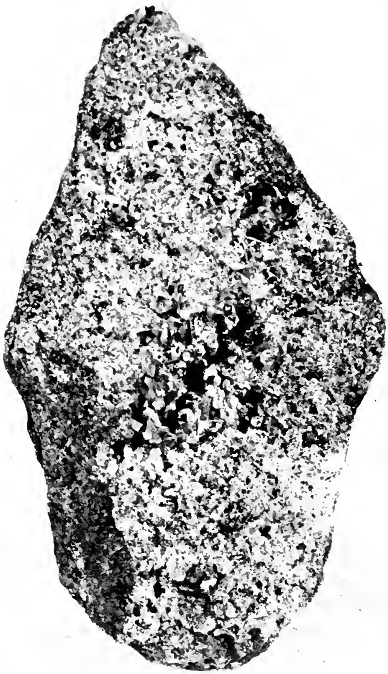


Fig. 2. Specimen from quartz-quartzose reef showing vughs.

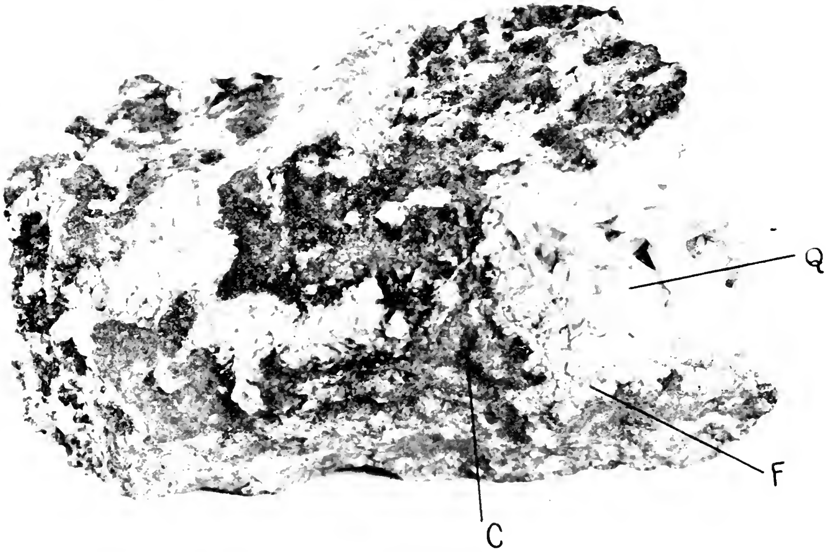


Fig. 1. Lode-material from Strand Mine, near Howell.

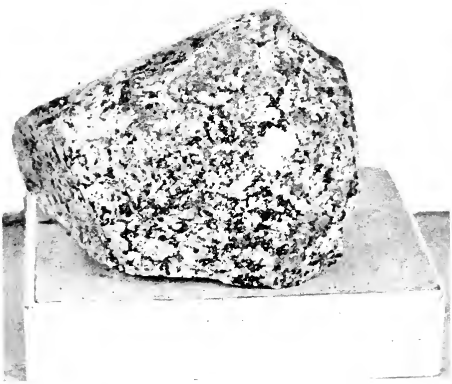


Fig. 2. Cassiterite in quartz-felspar lode-material.

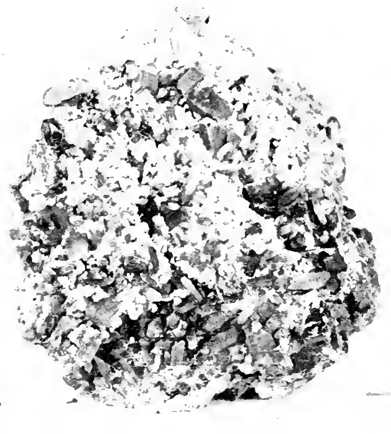


Fig. 3. Quartz and felspar intimately intergrown.

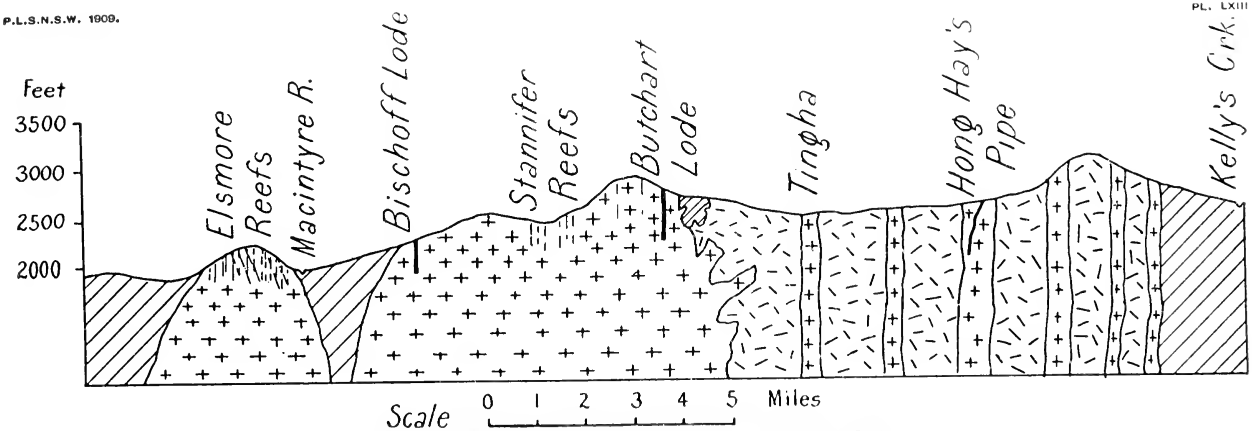


Fig. 1. Section from Elsmore to Kelly's Creek (P-P. on Map).

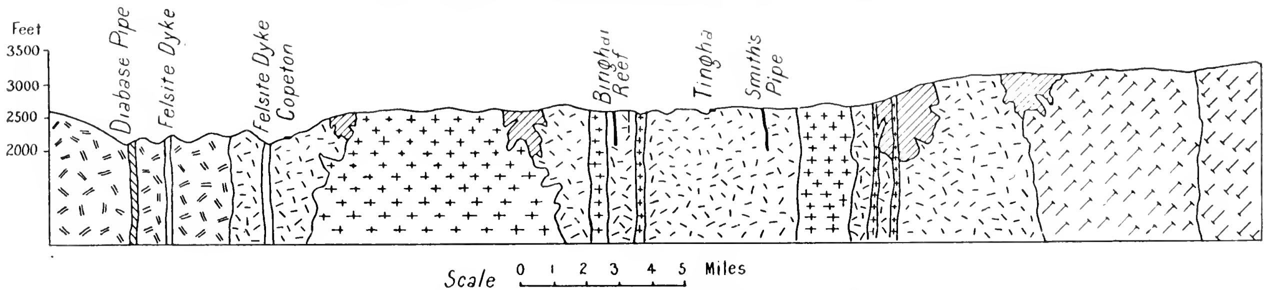
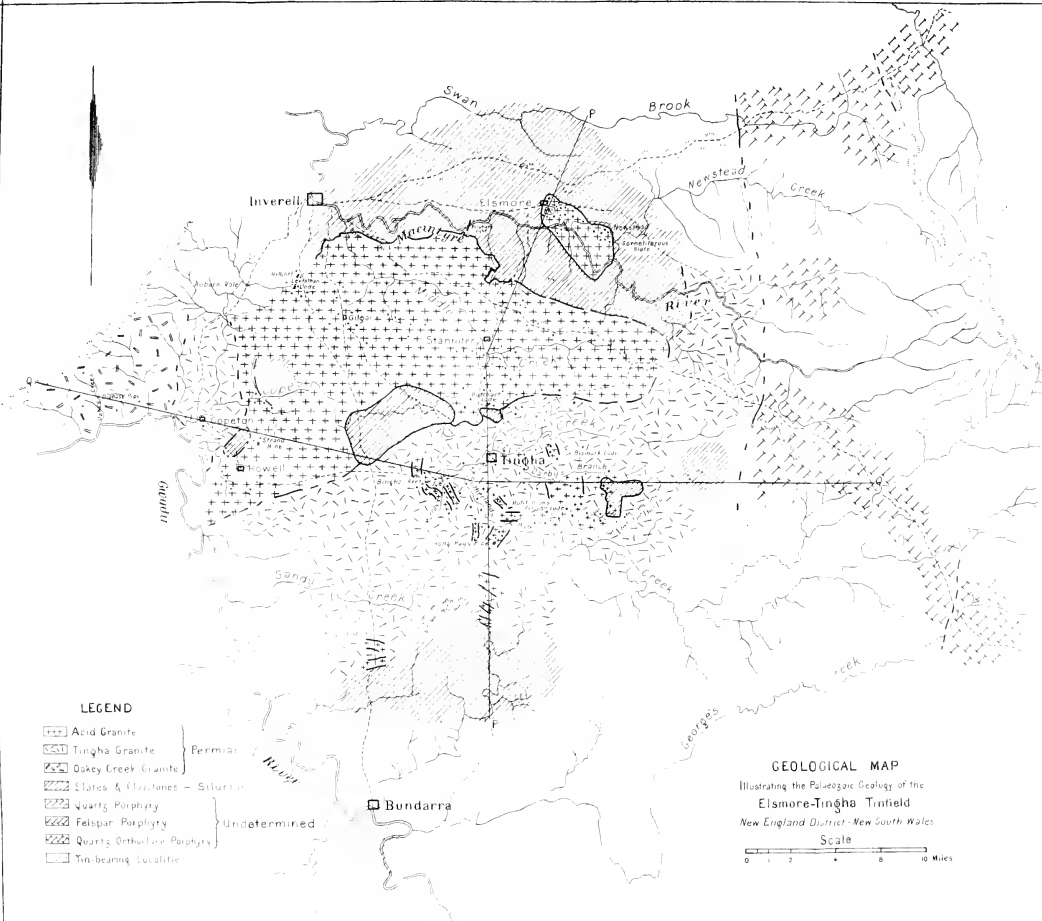
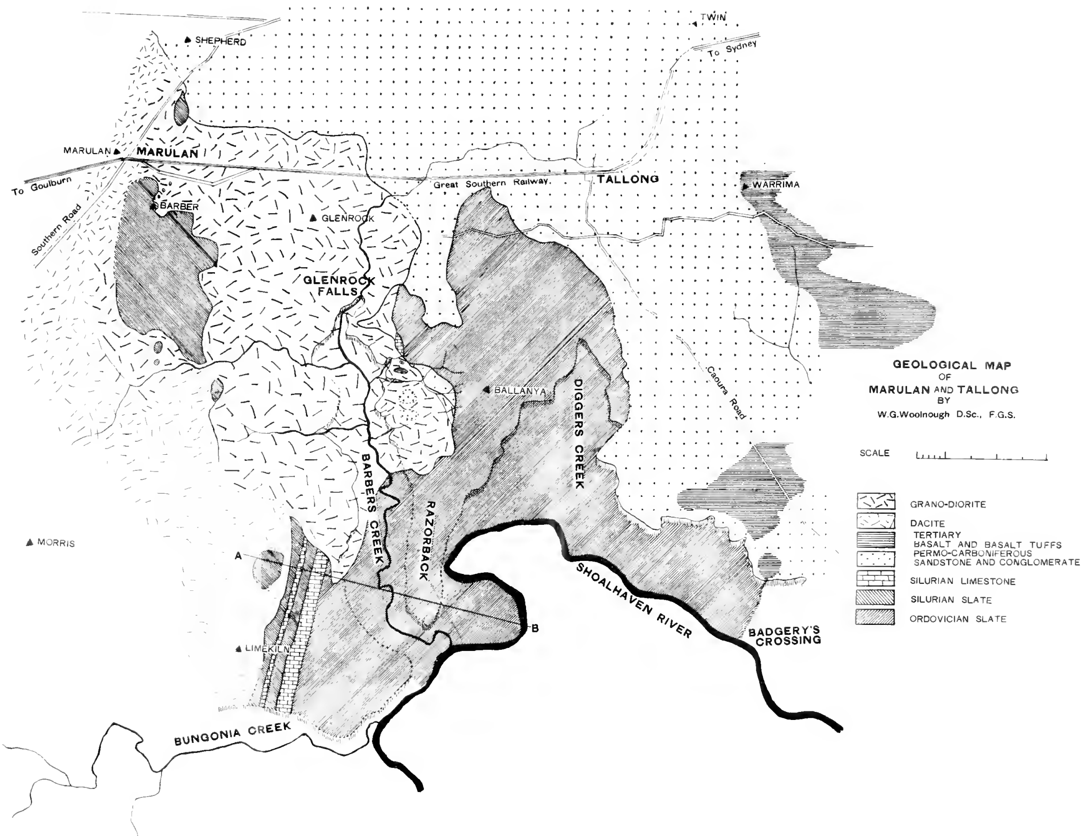


Fig. 2. Section from Oakey Creek to Wandsworth (Q-Q on Map).


Swan Brook
Newstead Creek
Inverell
Elsmore
Newstead
Macintyre River
Auburn Vale
Gilgai
Stannifer
Copeton
Howell
Tingha
Darby's Branch
Bundarra
Gwydir River
Sandy Creek
George's Creek
P
Q
LEGEND
Acid Granite
Tingha Granite
Oakey Creek Granite
Permian
Slates & Claystones – Silurian
Quartz Porphyry
Felspar Porphyry
Quartz Orthoclase Porphyry
Undetermined
Tin-bearing Localities
GEOLOGICAL MAP
Illustrating the Palaeozoic Geology of the
Elsmore-Tingha Tinfield
New England District - New South Wales
Scale
0 1 2 4 8 10 Miles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OF
MARULAN AND TALLONG
BY
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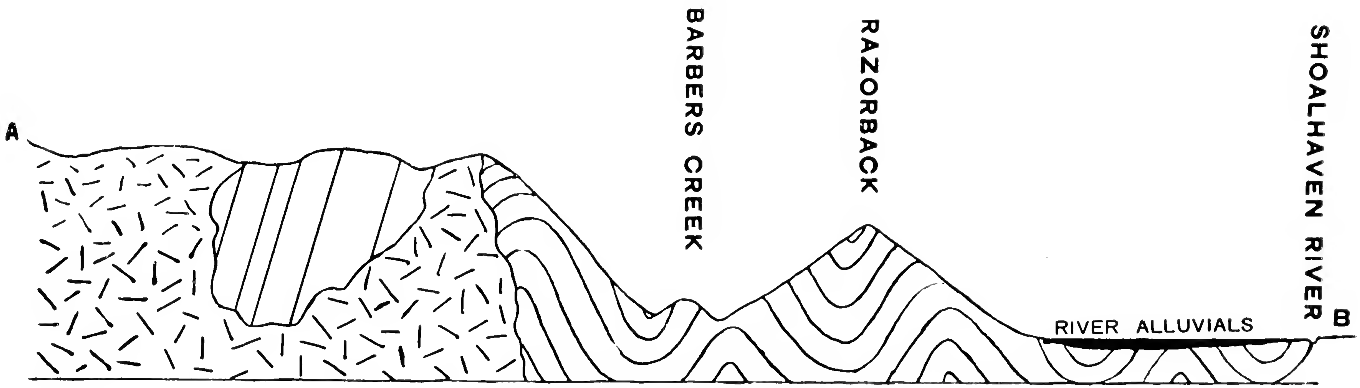
GRANO-DIORITE
DACITE
TERTIARY
BASALT AND BASALT TUFFS
PERMO-CARBONIFEROUS
SANDSTONE AND CONGLOMERATE
SILURIAN LIMESTONE
SILURIAN SLATE
ORDOVICIAN SLATE
SHEPHERD
TWIN
To Sydney
MARULAN
MARULAN
To Goulburn
Southern Road
Great Southern Railway.
TALLONG
WARRIMA
BARBER
GLENROCK
GLENROCK
FALLS
BALLANYA
DIGGERS CREEK
Caoura Road
BARBERS CREEK
RAZORBACK
MORRIS
A
B
LIMEKILN
SHOALHAVEN RIVER
BADGERY'S
CROSSING
BUNGONIA CREEK

GEOLOGICAL SECTION FROM A TO B



Geological Section from A-B, (Plate LXV.).

Fig. 1. Razorback, looking south.

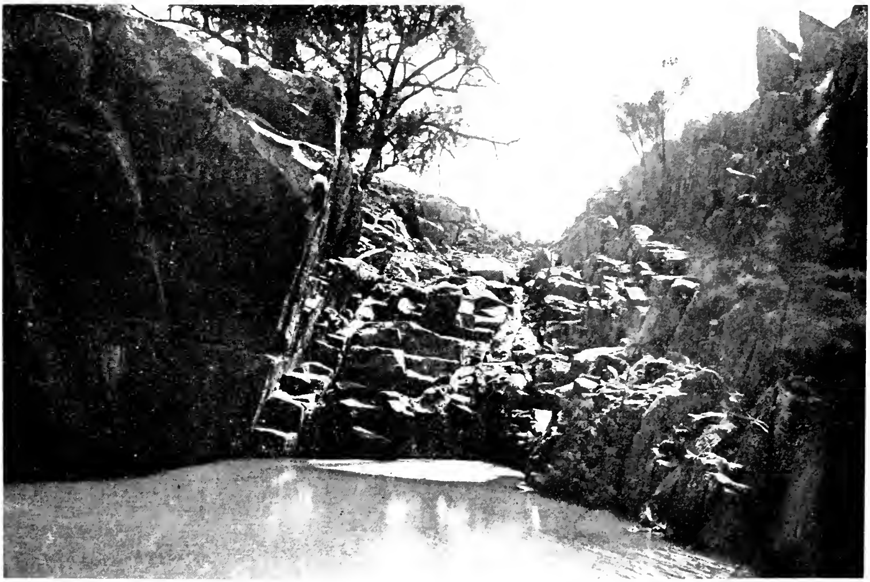


Fig. 2. Glenrock grano-diorite, Marulan Creek.

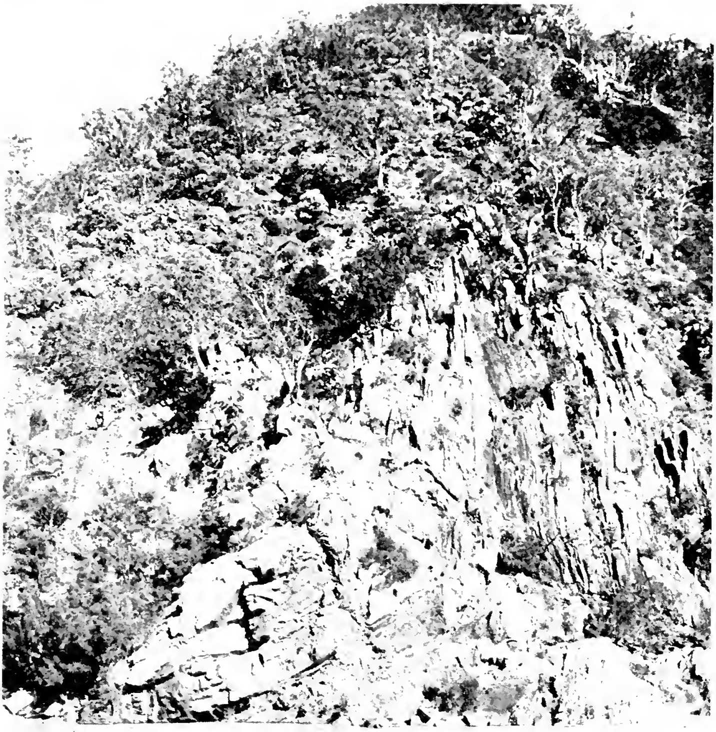
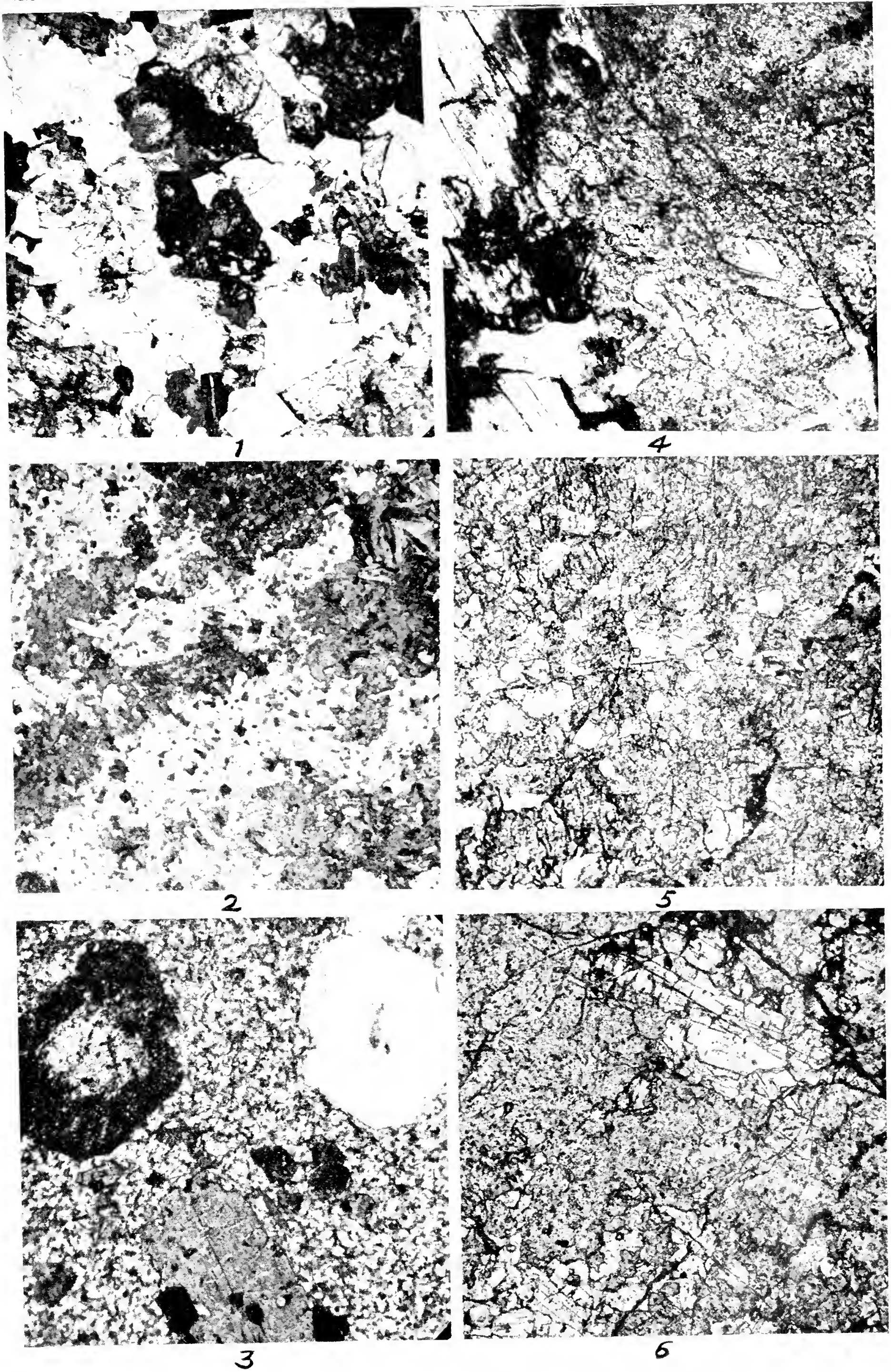


Fig. 1. Highly contorted Ordovician (?) Slates, Shoalhaven River.

Fig. 2. Lower Limestone-belt (Silurian), Marulan.



1. Grano-diorite. 2. Granite-porphyry. 3. Dacite. 4-6. Nos. 2, 4, 6 of Contact Series.

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Vol. XXXIV.
Part 1.

No. 133.

THE

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regions were being relatively superelevated by the intrusion of laccolites, or expansion of old sediments (*e.g.*, New England, The Blue Mountains). (4) These differential movements led to gentle folding in places; to fresh faulting in other places; in others to further slipping along old fractures. In some localities lavas were expelled.

In this way an old Tertiary (early Eocene) peneplain, in this case probably the Mole Plain of New England, has been so shifted about, that to-day it occupies widely different levels in different places. Originally it was all as level as the flat country surrounding the Gulf of Carpentaria to-day.

The correlation of these peneplains, at present a matter of speculation, should prove interesting work for physiographic students.

EXPLANATION OF PLATES VII.-IX.

Plate vii.

Geological Map of the Canobolas Mountains, N.S.W.

Plate viii.

Fig. 1.—The Orange-Blue Mountains Peneplain in the foreground, with the Canobolas Mountains in the distance.

Fig. 2.—Upper surface of an andesite-flow in the foreground, with the Canobolas Mountains in the distance.

Plate ix.

Part of an andesite-flow—Hopetoun Falls, Canobolas Mountains.

which led to the greatest downthrow of the more westerly blocks. The level of the original peneplain is probably represented by the mesas averaging from 1,800 to 2,000 feet. The 3,000-feet level is the effect of differential uplift and hypabyssal intrusions. The 1,400-feet level is the result of downthrow, and exposure to wind-erosion in the absence of the protecting lavas. The strip on which Narrabri is situated has undergone a much greater downthrow.

To summarise, the processes have been

(a) Monoclinal folding of a peneplain, and intrusion of laccolites, leading conjointly to the formation of a conoplain superimposed on a gentle fold.

(b) Expulsion of lavas.

(c) Step-faulting with progressive downthrow to the west. Further lava-flows.

These processes cut up the original peneplain into three main levels: (1) 2,700 to 3,000 feet; (2) 1,800 to 2,000 feet; (3) 1,400 feet.

The original peneplain was probably coextensive with that on which the Warrumbungle lavas rest (elevation 2,000 feet). The latter was also arched up by intrusions so that it reaches a height of nearly 3,000 feet in the heart of the mountains. The same peneplain extends to Dubbo, where it has an altitude of about 1,000 feet, and has alkaline lavas resting on it. Probably it is this same peneplain we meet again at a level of 3,000 feet in the Canobolas Mountains.

To account for this, we have to imagine that—(1) After the period of Cretaceous sedimentation over the area between Dubbo and Bourke, all the country, for 250 miles or so from the Cretaceous shore, had been reduced to a peneplain. (2) The Cretaceous sea withdrew, either as the result of a general lowering of sea-level (Suess), or as the result of a general uplift of the whole of the continent. (3) The area occupied by the Cretaceous transgression continued to subside relatively to the rest of the continent, as a result of secular contraction; other surrounding

PROCEEDINGS, 1909, PART 1.

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Correction.—Proceedings for 1908, Part 4, p.760, line 9—the word "glacial" has been inadvertently transposed from the end to the beginning of the line.

Issued September 15th, 1909.

Vol. XXXIV.
Part 2.

No. 134.

THE PROCEEDINGS OF THE LINNEAN SOCIETY OF NEW SOUTH WALES

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Issued December 3rd, 1909.

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Part 3.

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By R. Greig-Smith, D.Sc., Macleay Bacteriologist to the Society.

(With eight text-figs.)

When normal serum is progressively diluted with physiological salt solution, the opsonic activity is found to rise with the dilution to a certain point and then fall. This was noted by Wright and Douglas,* and was confirmed during my work.† Dean‡ showed later that the phenomenon was probably caused by two factors, one of which causes a sharp rise from infinity to a point at the quarter dilution when another factor comes into play and, retarding the rapid rise, causes a fall in the curve from the half dilution to the undiluted serum. In my own experiment this point agreed with the $\frac{1}{6}$ dilution, and, in Wright and Douglas's experiment, it was probably at the $\frac{1}{12}$. As Dean has taken the average of a greater number of experiments, his number is more trustworthy, although it must be remembered that he probably made his tests by the more modern method of using the serum and suspensions of corpuscles and bacteria in the ratio of 1:1:1, while both Wright and I used the older ratio of 3:3:1. The greater proportion of serum to saline might cause the differences between the points when the depressing action of the serum appears.

In endeavouring to account for the behaviour of the serum upon the dilution, much might be gained by remembering that opsonisation, while possibly not identical with, may still be closely related to agglutination. In a former paper I showed that they were probably identical; and recently Weil,‖ in a

* Proc. Roy. Soc. 73, (1903), No.483, p.364.
† These Proceedings, 1905, p.563.
‡ Proc. Roy. Soc 79, (1907), No.B 533, p.401.
‖ Centrlb. für Bakt. Ref. 42 (1908), p.345.

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Note.—In Plate LXV., the divisions on the left hand end of the scale represent hundreds of yards; those on the right hand end, quarter-miles.